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The Research Career Award (K06): A 20-Year Perspective and an Analysis of Research Productivity

Submitted to the National Institutes of Health September 1984, by Seiichi Yasumura, Department of Physiology, SUNY Downstate Medical Center; and Medical Research Center, Brookhaven National Laboratory.

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ABBREVIATIONS

K06	Research Career Award
K06APP	Research Career Awardee
K06REJ	Research Career Award Reject and Application disapproved by initial review group
PR100	Control group with priority scores of 100-149 regular research grants (R01)
PR150	Control group with priority scores of 150-199 on regular research grants (R01)
PR300	Control group with priority scores of 300-349 on regular research grants (R01)
CGAF	Consolidated Grant Application File
R01	Regular investigator-initiated research grant

PURPOSE OF STUDY

This study was undertaken to provide background material for the ongoing discussions at the National Institutes of Health on the merits of providing salary support for research scientists. As more and more time is spent on the process of obtaining grand funds there is concern that some first-rate people are leaving research as a way of life. Even more troubling is the perception that some of our brightest students are being discouraged from entering the biomedical research fields. The pressure to publish is great, and often research projects take on a conservative "safe" approach to assure a steady output of papers in areas of work known to be "in" with peer review committees.

The traditional individual project grants are the backbone of the National Institutes of Health system that has led to great advances in science. There is no reason to abandon a system that has served so many interests so well, but there should be room to allow scientists with high potential to explore areas in depth without the pressures of short-term reviews. Recently, the National Institutes of Health has selectively extended the time period by 2 or 3 years on grants with the "best" priority scores. The justification for bypassing the competitive renewal process is the belief that a scientist with a good track record evinced in the priority score, reflecting peer review judgments, will continue to produce at a high level and that his work will benefit from a reduction in the pressures associated with grant renewal applications and the time required to submit them.

The K06 program was unique; it provided lifetime salary support for a select group of scientists. The concerns that led to the creation of this program were similar in many ways to those being discussed currently, namely, is there

any merit in supporting scientists over longer time periods without the usual periodic short-term reviews?

Thus, it is important to evaluate the Research Career Award particularly within the historical context. The purpose of this report is to document the K06 program in the hope of providing some help for future manpower planning. It is unlikely that a program similar to the Research Career Award will be proposed again but new support mechanisms should incorporate the best aspects of the K06 program while avoiding some of the mistakes and problems that were encountered along the way.

HISTORICAL OVERVIEW*

A report entitled "Federal Support of Medical Research" was prepared for the Committee on Appropriations of the United States Senate in May 1960. This report recommended that "funds should be provided for the National Institutes of Health in FY 1961 to support the establishment of 200 research professorships in medical and dental schools and the basic science departments of colleges and universities at a salary level of $20,000 a year, the funds to be made available to and administered by the respective institutions." In testimony before the House Appropriations Committee, Dr. James A. Shannon (Director, NIH 1955-1968) argued that the development of important long-range research programs was limited by the lack of competent investigators willing to dedicate their lives to a career in research. Thus, there emerged an expansion of the federal research policy from one of supporting research only in the narrow sense to one of providing support for a sound scientific research program in the medical sciences for the indefinite future.

In 1961, Congress appropriated $2 million to establish the NIH Research Professorship Award. The guidelines stated that schools could nominate qualified individuals with a "demonstrated capacity to pursue with distinction a professional career in independent research and teaching in medicine, dentistry, public health and related sciences." Institutions were invited to nominate tenured candidates with a stable source of salary support, with the stipulation that the "released" money would be used for other professional positions within the school. Reaction to these guidelines was immediate and unexpectedly negative. Some institutions were reluctant to subject their leading professors to

*Shannon, JA and CV Kidd, Federal Support of Research Careers, Science 134: 139-1402, 1961.

*Walsh, J, NIH: Monitorium on Career Awards for Researchers Called for Blend of Budgetary and Policy Reasons, Science 145: 1283-1284, 1964.

national competition with each other or with professors from other universities. Many schools refused to make nominations because they feared the intrusion of the Federal government into the policy affairs of the university.

Even more troubling was the absence of a real commitment on the part of the government to long-term (lifetime) support. The awards were offered for an initial five-year term only, with a promise of support for additional years contingent upon annual congressional appropriations. In part, because of the short-term nature of these awards, many schools nominated distinguished individuals who were nearing the end of their careers.

Senior administrators at the NIH reacted with apprehension as these nominations were received. Clearly, the intent of Congress to provide additional stable research positions would not be met by supporting older full professors, however distinguished, in the waning years of their research productivity. They also realized that the program, as promulgated by the guidelines, might have the effect of releasing university funds formerly used to pay full professors to hire unproven junior faculty. Although this effect might not be undesirable, it did not meet the objective of providing stable career support for outstanding investigators who might otherwise be lost from the pool of qualified medical scientists.

In the spring of 1961, a highly unusual decision was made to return the $2 million to the U.S. Treasury, return all applications for the Research Professorship Award to the institutions, and issue new guidelines. In July 1961, the program was renamed the "Research Career Award," thus avoiding nomenclature which implied that the Federal government was selecting professors. Also, the use of the word "career" was deliberate, the inference being that the award was for lifetime support of one's entire research career. These new

guidelines sharpened the policies to more clearly show the intent of Congress; the primary purpose was to increase the number of research positions financed from more stable funds. Accordingly, the guidelines placed emphasis on the selection process which would give preference to candidates whose incomes were derived primarily from research grants or contracts and similar sources of relatively short duration. The intent was not to confer a prize for outstanding scientific excellence but to provide "increased numbers of stable career opportunities for scientists of superior potential and capability in the sciences related to health." Also germane to the overall selection process was the understanding that the initial award be made to most candidates before they became 45 years of age. The guidelines tended to discourage nominations of the most senior professors which thereby eliminated many of the country's most distinguished scientists from the competition.

Since the awards were intended to compensate recipients adequately for full-time positions (up to $25,000 plus fringe benefits), they were expected to devote most of their time to research and teaching. Awardees could engage in clinical work in order to maintain their professional skills but were not allowed to retain personal incomes from the practice of their professions. By 1962, only one year into the program, 14 of the first 155 awardees were already receiving the maximum $25,000. Salaries had to be consistent with the established salary structure in operation at the institution, but in no case could the awardee receive income from the institution in addition to the amount provided through the award. This policy discouraged a number of outstanding investigators who were earning nearly as much as or more than the maximum allowed under the guidelines, as did the further limitation that deterred the awardees from devoting themselves substantially to activities other than re-

search and teaching. This was generally interpreted to include administrative responsibilities, although the vagueness of the guidelines led to some differences in their application by the different institutes within the NIH. Deans were generally excluded but chairmen, chiefs/directors or clinical divisions/services, or those with local titles such as Assistant Dean, Deputy Chairman, etc. were sometimes treated inconsistently. The overall effect was to discourage applications from a highly qualified group of individuals, many of whom were outstanding investigators. In fact, applications were often withdrawn by an institution or disqualified by NIH program directors prior to the review process, because of this policy limitation.

There were major differences in the interpretation of the guidelines concerning the nomination of tenured professors. Some institutions submitted applications on behalf of individuals with high research potential receiving income from grants or contracts, whereas others nominated senior tenured faculty with distinguished records of achievement. Review committees rendered judgments on scientific competence but tended to pass over administrative matters. It was extremely difficult for advisory panels to give preference to an untenured person with high potential, over a person of the first academic rank with tenure. Although, in many cases the NIH staff determined administratively the eligibility of candidates to enter the competition for awards, this type of pre-review determination was inevitably uneven and inconsistent, and thus a degree of heterogeneity emerged in the qualifications of the applicant pool.

By the spring of 1964, 236 (243 less 7 early terminations) career awards had been made, exceeding by 36 the number earmarked by Congress in 1961. NIH announced a moritorium on new Research Career Awards in June 1964, in part, because the growth rate of the NIH budget was slowing. The annual cost of the pro-

gram was $5.5 million and would increase in future years even without additional awards, since all awardees would eventually advance to the $25,000 maximum. However, it was not the projected cost alone which led to the termination of the program. Congress, as well as senior administrators at the NIH, was uneasy about supporting individuals in research that was vague and less well defined than research traditionally sponsored under grant awards with clearly specified aims and long-range goals. Congress has always been subject to powerful political pressure to support research into the causes and cures of specific diseases, and any salary support was justifiable only as a necessary adjunct to those program goals.

At the same time that the Federal government was having misgivings about the concept of lifetime support, many institutions were uncomfortable with the triangular relationship developing between the Federal government, university, and research scientist. The schools had lost a measure of control over some of their most valuable and visible faculty; the overall effect was to alter institutional prerogatives concerning conditions of employment. In fact, many schools declined to nominate candidates for this reason.

Finally, the NIH staff was concerned that as the Research Career Awardees grew older the quality of their research would decline. This concern was coupled with the fact that a further commitment of funds to career support would seriously reduce research training support to many qualified individuals in the younger age groups.

PROFILE OF THE K06 AWARDEES

Essentially all awards had been made by mid-1964 and by early 1965 243 grants had been awarded. Table 1 lists the institutions and state distribution of all K06 recipients. The distribution of K06 Awards by Institute is shown

Table 1

Distribution of All Research Career Awards by Institution July 1964

Alabama	
University of Alabama Medical Center	2
University of Alabama Dental School	1
	3
California	
California State College	1
Loma Linda Medical School	2
Scripps Clinic	2
Stanford University Graduate School	1
Stanford University School of Medicine	4
UCLA Graduate School	1
UCLA School of Medicine	3
UCLA Dental School	1
UC San Fransisco	3
USC Dental School	1
	19
Colorado	
University of Colorado Medical School	1
	1
Connecticut	
University of Connecticut	1
University of Connecticut Graduate School	1
Yale University School of Medicine	5
	7
Florida	
Communications Institute	1
Northwestern University Graduate School	1
Northwestern University Medical School	4
University of Chicago Graduate School	1
University of Chicago School of Medicine	6
University of Illinois Graduate School	4
University of Illinois College of Medicine	1
	18
Indiana	
Indiana University	1
Purdue University	1
	2
Iowa	
State University of Iowa Medical School	3
	3
Kansas	
University of Kansas Graduate School	1
University of Kansas Medical School	3
	4

Table 1 (Continued)

Kentucky	
University of Kentucky Medical School	1
University of Louisville Medical School	2
	3
Louisiana	
LSU Medical School	1
Tulane University of Medical School	2
Tulane University School of Public Health	1
	4
Maine	
Jackson Memorial Laboratory	1
Maine Medical Center	1
	2
Maryland	
Johns Hopkins University Graduate School	1
Johns Hopkins University School of Public Health	3
Johns Hopkins University School of Medicine	4
University of Maryland Medical School	1
	9
Massachusetts	
Brandeis University Graduate School	1
Boston University Medical School	4
Children's Cancer Research Foundation	1
Harvard University Dental School	1
Harvard University Graduate School	1
Harvard University Medical School	1
Harvard University School of Public Health	2
MIT	1
New England Center Hospital	2
Tufts University Graduate School	1
Tufts University Medical School	3
Worcester Foundation Experimental Medicine	2
	20
Michigan	
University of Michigan Graduate School	1
University of Michigan Institute for Social Research	1
University of Michigan Medical School	2
University of Michigan School of Public Health	1
Wayne State University College of Medicine	1
	6
Minnesota	
University of Minnesota Graduate School	1
University of Minnesota Medical School	3
	4

Table 1 (Continued)

Missouri	
St. Louis University School of Medicine	1
University of Missouri Graduate School	1
Washington University Medical School	6
	8
Montana	
Montana University Graduate School	1
	1
Nebraska	
Creighton University School of Medicine	1
	1
New Hampshire	
Dartmouth Medical School	2
	2
New Jersey	
Rutgers State University Graduate School	1
	1
New York	
Albert Einstein Medical Center	7
City University of New York	1
Columbia University College of Physicians & Surgeons	6
Cornell University Graduate School	3
Cornell University Medical School	3
New York University Graduate School	3
New York University Medical Center	4
Sloan Kettering	2
State University of New York, Buffalo	2
State University of New York, Downstate Medical Center	1
Universty of Rochester Graduate School	1
University of Rochester School of Medicine	3
	36
North Carolina	
Bowman-Gray School of Medicine	1
Duke University Medical Center	5
University of North Carolina	4
	10
Ohio	
University of Cincinnati Medical School	1
Western Reserve Medical College	9
Western Reserve Graduate School	1
	11
Oklahoma	
Oklahoma University School of Medicine	1
	1

Table 1 (Continued)

Oregon	
University of Oregon Medical School	1
	1
Pennsylvania	
Jefferson Medical College	2
Seton Hall College of Medicine	1
Temple University Medical School	1
University of Pennsylvania School of Medicine	5
University of Pittsburgh Graduate School	1
University of Pittsburgh Medical School	3
Wistar Institute	1
	14
Tennessee	
University of Tennessee Memorial Research Center	1
University of Tennessee Medical Center, Memphis	3
Vanderbilt School of Medicine	2
	6
Texas	
Baylor University College of Medicine	2
Rice Institute Graduate School	1
Texas A and M	1
Univeristy of Texas Graduate School	3
University of Texas, M.D. Anderson Hospital	1
University of Texas Southwestern	4
	12
Utah	
Latter Day Saints Hospital Fdn. for Research	1
University of Utah College of Medicine	4
	5
Vermont	
University of Vermont College of Medicine	3
	3
Virginia	
Medical College of Virginia	2
University of Virginia College of Medicine	1
	3
Washington	
University of Washington Medical School	4
	4
West Virginia	
West Virginia Medical School	1
	1

Table 1 (Continued)

Wisconsin	
University of Wisconsin Graduate Schoool (Incl. Inst. Enzyme Res.)	5
University of Wisconsin Medical School	4
	9
Puerto Rico	
University of Puerto Rico Medical School	1
	1
Total	236*

*Seven early terminations not included.

in Table 2. For technical or administrative reasons seven early terminations occurred within the first month or so after the award was made. An additional 20 awardees departed from the program within the first two years, primarily because of a change in institutional affiliation. Under the terms of the award, when an awardee moved to a new institution the award was terminated for both the individual and the institution. Thus 216 individuals remained in the program in FY 1965 (see Figure 1) and the attrition rate was approximately 12 per year until 1972. From 1972 to 1981 this number dropped to only 5 per year for reasons unknown, although it is speculated that most of those for whom a move meant a major career advancement had made that move before 1972, at which time the group's average age was 53.

Table 2

Distribution of Research Career Awards by NIH Unit

Name of NIH institutes in 1984	Number of awards 1962-1964	Number of awardees still being funded FY 1984
National Heart, Lung, Blood Institute (HL)	42	17
National Institute of Arthritis, Diabetes (AM) and Digestive and Kidney Diseases	42	9
National Institute of Mental Health (MH)	28	5
National Institute of Dental Research (DE)	4	0
National Institute of General Medical Sciences (GM)	54	14
National Cancer Institute (CA)	20	5
National Institute of Neurological and Communicative Disorders and Stroke (NS)	16	3
National Institute of Allergy and Infectious Diseases (NS)	32	10
National Institute of Child Health and Human Development (HD)	5	2
	243	65

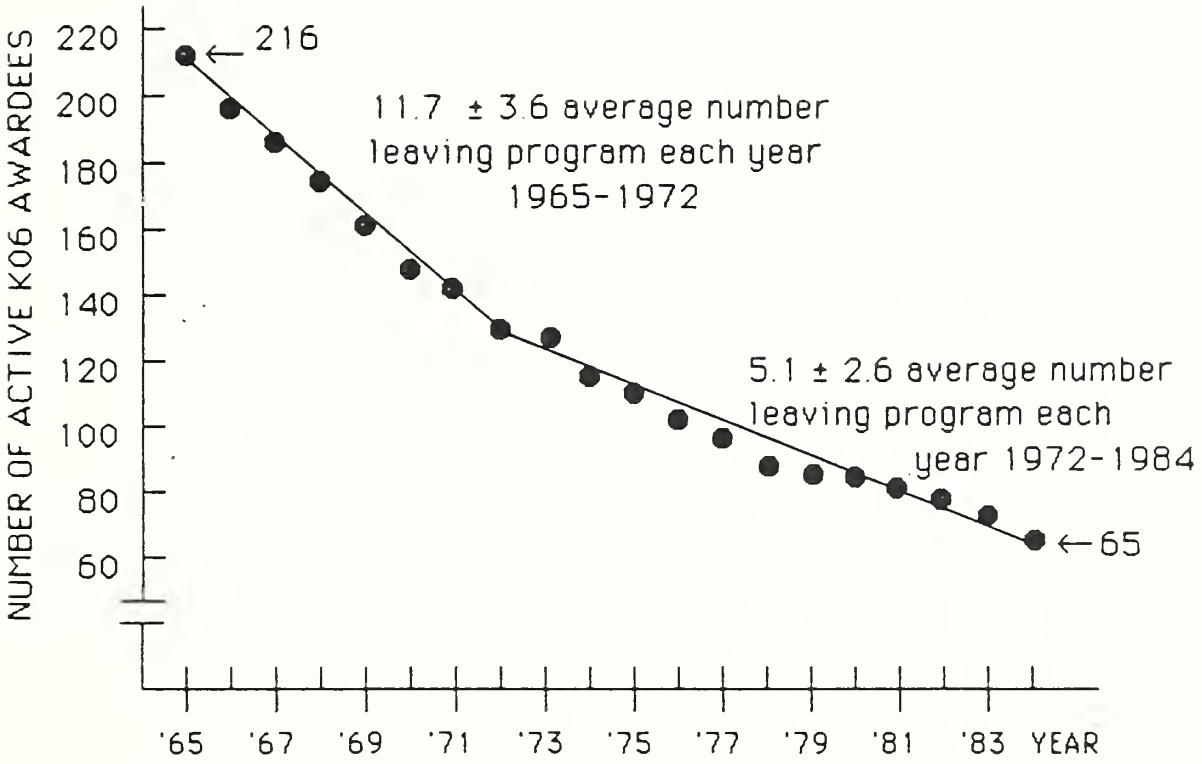

Figure 1. Number of Research Career Awardees leaving the program 1965-1981.

INTRODUCTION TO THE PRESENT STUDY

More than 20 years have passed since the last Research Career Award (K06) was made. During that time a number of internal memos at the level of individual institutes within NIH were prepared to document the progress of their awardees but no centralized tracking system was maintained. The manner in which the K06 awards were made (see Table 3) and how progress reports and 5-year reviews were handled varied considerably among the awarding units. Some institutes required only staff review, some provided review by outside consultants, and some provided final review by their advisory councils. In short, the overall program has never been evaluated except for one unpublished internal study conducted by Dr. R.L. Gulley (NIGMS) early in 1981. This study was inspired in part by concern that a program similar in concept to the Research Career Award might be reinstituted. His evaluation centered around the issue of whether or not the expenditure of some $60 million over the lifetime of the program yielded benefits unobtainable without this form of support. He used the rate of publication as the primary study end point and compared the performance of K06 recipients against two groups of 50 individuals with priority scores of 100 to 149 on individual investigator-initiated research grant applications (R01 grants) and those with priority scores between 150 and 199, which were modestly lower in rated quality. The rationale for using the R01 application priority score was that the score represented a measure of peer evaluation of the quality of the investigator's research. The present study uses similar control groups.

The major constraint in the present study was the lack of a survey instrument or any direct contact with career awardees or anyone in the control groups. This placed a major limitation on the range of variables which could be used. This limitation, does not seriously affect the validity of the conclu-

Table 3

Differences in NIH Review Procedures by Institute for Research Career Award (K06) Applications in 1964

Institute	Initial review for scientific merit	Final review
National Institute of Neurological & Communicative Disorders & Stroke, National Institute of Allergy & Infectious Diseases, National Institute of Dental Research, National Heart Lung Blood Institute	Existing training review committees of outside consultants	Advisory Council
National Institute of Mental Health	Special K06 review committee by outside consultants	Same review committee except split vote applications went to Advisory Council
National Institute Arthritis, Diabetes of Digestive & Kidney Diseases	Special K06 review committee outside consultants	None
National Cancer Institute	Regular Division of Research Grants (DRG) Study Section	Advisory Council

sions since most of unmeasured career end points such as the rate of academic advancement, honors, invited papers, number of graduate students, etc. would be expected to correlate with the more general measures of achievement such as publication rate, citation rate, and years of continuous project grant support. Nevertheless, if future studies are contemplated, these points should be carefully documented to provide a more complete picture of career achievements.

This study was composed of two parts. The first was a pilot study designed to test the feasibility of obtaining meaningful data from readily available data bases without having to resort to the use of questionnaires. The second, reported here, is an enlarged version of the pilot study incorporating the suggestions provided by an ad hoc concept review committee (Drs. Doris Merritt, William Batchelor, Charles Sherman, Helen Gee, and Paul Lenz), and additional input from Drs. Gee and Sherman during the intermediate stages of data analysis.

Group Selection Process

A subfile of all Research Career Award (K06) applicants was created from the Consolidated Grant Applicant File (CGAF) (a tape was kindly provided by Dr. Stuart Wright, Research Analysis and Evaluation Branch, Division of Research Grants, NIH, under Dr. John James). The disposition of the applicants is shown in Table 4. From this subfile all K06 awardees and all unsuccessful applicants (those disapproved by the initial review committee) were grouped and named K06APP and K06REJ, respectively. Three control groups were selected at random from the Consolidated Grant Applicant File (kindly provided by Dr. Doris Wallace, Research Analysis and Evaluation Branch, DRG, NIH). Sample selection was based on the highest-priority score obtained on R01 grant applications between 1961 and 1965. The groups chosen were those with priority scores between

Table 4

Status of Applications for the Research Career Award (K06) 1962 - 1965

		Number of applications	Percentage of total
Total applications submitted		455	100
Administrative withdrawal of applications prior to review		117	26
By NIH Institute	86		
By applicant institution	12		
Deferred unfunded	10		
Miscellaneous other unfunded	9		
Disapproved by review panel		92	20
Approved but unfunded (low-priority score)		3	1
Approved and funded		243	53

100 and 149, 150 and 199, and 300 and 349, named PR100, PR150, and PR300. Thus, the five groups included in this study are:

K06APP = All K06 Research Career Awardees (approved and funded)

PR100 = A sample of investigators receiving the best priority scores 100 to 149, on R01 grant applications

PR150 = A sample of investigators receiving R01 priority scores 150 to 199, only slightly lower than PR100

PR300 = A sample of investigators receiving less than average R01 priority scores of 300 to 349

K06REJ = All K06 applicants rejected by the initial review group

Only three individuals with approved K06 applications went unfunded because of low-priority scores, and therefore this group was not included for analysis. Also, 117 applications were administratively withdrawn either by the NIH or by the applicant institution prior to review. Some of these nominees were deemed ineligible because they held administrative positions. However, since no centralized records giving reasons in all cases of administrative withdrawal were avaliable, this group could not be included in the study.

Age Matching

The fact that PR100, PR150 and PR300 groups were selected on the basis of priority scores assessed on R01 applications submitted between 1961 and 1965, the years when the Research Career Awards were made, resulted in a reasonable matching of ages across the groups. Nevertheless, individuals older or younger than the age range of K06 groups were deleted. Unfortunately, age of the individual applicants was not captured by either the CGAF or IMPAC system, and this information had to be obtained from other sources such as the American Men and Women in Science. Table 5 shows the average ages by group.

Table 5

Average Age by Group in 1964

K06APP	PR100	PR150	PR300	K06REJ
46.5 ± 6.2 (230)	45.8 ± 8.0 (127)	43.1 ± 7.9 (179)	43.1 ± 6.9 (111)	47.5 ± 6.5 (80)

Age in years: mean ± S.D. (counts in parentheses).

Discipline Matching

Because of the differences in the average publication and/or citation rates by research field or discipline, some attempts were made to divide each group into subfields to account for these expected differences. Yet, inclusion of too many subfield groupings would have seriously reduced the number of indivuals in each cell and rendered statistical comparison invalid. Therefore, some aggregation of fields becomes necessary in a study of this size.

In a somewhat arbitrary fashion, six general discipline groupings were formed as follows:

Basic sciences except biochemistry (BSC)

Biochemistry (BMC)

Medical specialties including Medicine, Pediatrics, and Pathology (ME)

Surgical specialties (SURG)

Behavioral sciences (PSYCH)

Miscellaneous other fields (OTH)

Biochemistry was separated from the other basic sciences with the knowledge that biochemists are cited more often.* The surgical specialists and behavioral sciences were first analyzed as separate groups, but their responses were generally similar to each other's as well as to those of the miscellany group. Thus, the surgical, behavioral, and miscellany groups were combined and labeled Other. In part, these categories are based on expected citation rates by subfield, but some fields were grouped together because of the related nature of the departmental affiliation (e.g., clinical vs basic science). The number of K06 awardees included in each group is shown in Table 6.

*Marin, F. and P.R. McAllister, 1982, subfield-by-subfield citation frequency distribution for U.S. papers. Washington, D.C., National Science Foundation.

Table 6

K06 Awardees Grouped According to Discipline or Specialty

	No. of K06 awardees
Basic Sciences (BSC)	59
Pharmacology	9
Physiology	9
Biophysics	9
Microbiology	20
Anatomy	7
Chemistry (Physical)	4
Physics	1
Biochemistry	31
Medical specialties (MED)	84
Medicine	54
Pediatrics	17
Pathology	13
Other (OTH)	67
General surgery	10
Ob-Gyn	2
Otolaryn	2
Ophthalmology	1
Anesthesiology	2
Psychiatry	5
Psychology	17
Public Health	6
Radiology	1
Oral Biology	1
Biology Science	9
Botany	2
Entomology	2
Zoology	3
Math	1
Anthropology	1
Ethics	1

Degree Matching

The K06 groups held the following degrees:

Table 7

Degrees Held by Awardees and Disapprovals

	K06 Awardee	K06 Disapprovals
PhD	110	50
MD	108	19
MD-PhD	8	8
DVM	-	2
DVM-PhD	3	-
DDS	1	-
MD-DMD	-	1
unknown	6	12
	236	92

Although the control PR100, PR150, and PR300 comparison groups were not chosen by matching the K06 degree distribution, sufficient numbers of PhD and MD degrees were available in each of the randomly selected control groups to make valid statistical comparisons. Separate analyses were not performed for individuals holding combined degrees or degrees other than MD or PhD because of inadequate numbers.

Measures of Productivity

The end points measured were: 1) the number of journal articles published (Medlars file 1966 - 1982 kindly provided by Yvonne Scott and Carolyn Tilley, Medlars Management Division, National Library of Medicine), 2) the number of

years of R01 (regular) and/or P01 (program) grant support (CGAF), and 3) the number of citations per individual in 1964, 1968, 1972, 1976, and 1980 (ISI Citation Index).

Medlars Data

All versions of each name* were submitted to the NLM for the Medlars file search. All articles published from 1966 to 1982 were listed by author(s), title, and source. Articles were enumerated by year of publication. Duplications, letters to the editor, obituaries, historical reminiscences, etc. were eliminated. Careful attention was paid to field of specialization (obtained from the CGAF or the American Men and Women in Science) in order to make authorship attribution as accurate as possible. Often, co-authorship(s) (overlap of the same name or set of names) was helpful in deciding whether a particular paper should be counted. In a few instances, the actual journal article was consulted to assign correct authorship. In such cases, the institutional affiliation of the author was usually sufficient to make the correct attribution decision.

Years of Grant Support

Most of the K06 population received NIH support through a regular research grant (R01) or a program project (P01) grant. Thus, the number of years of funding (in particular, continuous support) provides a measure of sustained research effort. Since each grant application is subject to peer review, the granting of an award implies that the investigator is maintaining an active research program of recognized merit. By the same token our use of R01 priority scores to select the control groups provided us with a pool of scientists who depended for the most part on the same research support mechanisms.

*Sherman, C.R. 1982, An evaluation of the Medlars method for estimating MD research activity. Washington, D.C., Association of American Medical Colleges.

The information on years of funding support is readily available from either the CGAF or the IMPAC file. However, the older the data, the less accurate they are because of omissions, changes in format, misfiling, etc., although in most cases, the number of years of long-term grant activity can be estimated from the years of support (grant year suffix of the grant ID numbering system).

In addition to research support, another measure of productivity is participation in graduate training programs. Thus, the number of individuals with training program support (T awards), as well as other types of grant support, has been captured as well.

Citation Counts

The number of citations in each of the years 1964, 1968, 1972, 1976, and 1980 was obtained by manual counts from library copies of the ISI Citation Index. The four-year interval was chosen because the increment of change of citation counts per author is known to be very small on a yearly basis (Dr. S. Cole, personal communication) and even after four years the number of citations changes very little on a group basis.

Self-citations were deleted from the count in this study, but it should be noted that their inclusion had no effect on the statistical analysis of group comparisons.

This part of the project was very time consuming. In addition to the enumeration process itself, eliminating counts because of the authorship attribution problems makes this a difficult task requiring some knowledge of biomedical terms combined with accounting skills. Computerized methods, although helpful, would not eliminate the need for manual correction of authorship attribution errors. Because of workload considerations, it was decided to count only those

Citations and publications were counted by Anders Carlson and Sebastian Platania.

citations for the years 1968 and 1976. This decision was based on the pilot study finding that the citation counts in any one year were highly correlated with all other years sampled (see Table 8 showing the correlation matrix). Also, the year 1968 is within five years of the time the Research Career Awards were made and the recipients were at an age (averaging 49 years) that they could be expected to have made some significant scientific contributions. The year 1976, eight years later, allows sufficient time to show (or not) a pattern of sustained effort.

Table 8

Correlation of Citation Counts in 1968 with Citation Counts in 1964 and 1972 (sample size in parentheses). Data from the Pilot Study

	K06APP	PR100	PR150	K06REJ	All (combined groups)
1964	0.92 (34)	0.85 (62)	0.69 (70)	0.83 (16)	0.84 (182)
1972	0.94 (34)	0.84 (63)	0.74 (70)	0.85 (16)	0.85 (183)

Correlation of Citation Counts in 1976 with Citation Counts in 1972 and 1980 (sample size in parentheses). Data from the Pilot Study

1972	0.92 (34)	0.95 (63)	0.88 (70)	0.88 (16)	0.84 (183)
1980	0.92 (34)	0.86 (62)	0.90 (70)	0.93 (16)	0.86 (182)

Much effort and emphasis were placed on careful data collection procedures. In part, this was accomplished by controlling the number of vari-

ables studied, and limiting the size of each control group in order to provide maximum accuracy of the data collected.

Statistical Methods*

The information on the Research Career Awardees (K06APP) and K06 disapprovals (K06REJ) was obtained for the entire population. Two of the measured variables, the publication and citation counts, have skewed distributions. Thus log-transformation was performed and the resulting transformed data were tested and found to be approximately normally distributed.

Means and standard deviations were calculated for the log-transformed data. These were inversely transformed to obtain the geometric means and 95% confidence intervals. For two variables, years of publication activity and years of regular research grant support, the data were normally distributed, and thus the arithmetic means and 95% confidence intervals were calculated. Mean values for the K06APP and K06REJ groups are whole population means and thus have no confidence interval ranges. Also, if the mean value of a K06 group falls outside the range of the 95% confidence interval of any control group (PR100, PR150, PR300), the difference between those means is significant at the 0.05 level.

Since there is no unique way to collapse all the variables into a single measure, multivariate methods were deemed inappropriate and in general not helpful in this study, and thus each variable was analyzed independently. Three grouping factors were used: group (K06APP, PR100, PR150, PR300, K06REJ), degree, and discipline. The influence of each factor is provided by the analysis of the following combinations: entire group, group by degree, group by discipline, and group by degree and discipline.

*All statistical analyses were computed by Kapo Yuen, Applied Mathematics Department, Brookhaven National Laboratory.

Pearson's correlations were computed to show the relationship between different citation years. Also, correlations were computed to test for the interrelationship among all study end points.

The general characteristics of the K06 groups, both awardees (K06APP) and disapproved (K06REJ), are provided in the form of five-number summary tables which include: minimum, lower quartile, median, upper quartile, and maximum for all study variables.

RESULTS

Tables 9 and 10 provide an overall summary of performance characteristics of the K06 awardee and disapproved groups. Note that the third quartile and maximum values for all variables involving publication or citation counts are very high. This is consistent with the fact that a small number of individuals publish and/or are cited way out of proportion to the rest of the group. It also illustrates why the mean, because it is skewed to the high side, is not an appropriate measure of the performance for the whole group. A better measure of achievement is provided by the median.

All tables are arranged in the same format with columns from left to right: K06APP, Research Career Awardees; PR100, a group with R01 priority scores between 100 and 149; PR150, scores between 150 and 199; PR300, scores between 300 and 349; and K06REJ, applicants disapproved at initial review. The data are presented as the arithmetic mean and the 95% confidence interval or as the geometric mean and 95% confidence interval whenever the data were distributed in a log-normal fashion. Since the entire K06APP and K06REJ populations were included, their mean values are true means and have no confidence intervals. This allows for simple and rapid comparisons with the PR control

groups, i.e., if the K06APP or K06REJ mean values are not within the range of the 95% confidence intervals they are significantly different at the 0.05 level.

The combined data on measures of research productivity are presented in Table 11. In most cases, the numbers for each variable are highest to lowest, moving from left to right on the page. Not all K06APP mean values are significantly greater than for all groups and not all K06REJ mean values are significantly lower. Nevertheless, the pattern clearly points to the K06APP as the "best" group in the aggregate and the K06REJ the "least successful". The K06APP population performed significantly better in some measures of productivity than the PR100 group and at least as well in the other measures of success. This is surprising since the average R01 priority scores for the K06APP groups was 186 ± 60 (mean ± SD). The K06REJ groups at the other end of the scale had an average R01 priority score of 241 ± 68 (mean ± SD) but performed at a level close to or lower than the PR300 group. The same criteria were used to obtain these priority scores as in the PR group selection process, i.e., the group average of the highest initial review group priority scores on R01 applications between 1961 and 1965. Thus, the performances of the K06APP and K06REJ groups were respectively better and worse than predicted by priority score alone.

The number of Principal Investigators in each group who received grants other than regular research R01 grants is shown in Table 12. The K06APP group received more grants of all types than any other group. It is particularly noteworthy that 50% of all K06 recipients held training grants, thus fulfilling one of the two major goals of the K06 program, research and training.

The remainder of the data shown in the following tables and figures provide more detail to analyze the effects of degree (PhD vs MD) and discipline

(basic science, biochemistry, medical specialties, and other). In general, the pattern of numbers is similar to the composite data shown in Table 11.

Tables 13 to 18 display the data by discipline. The biochemists and medical specialties group (medicine, pediatrics, and pathology) publish more frequently and are cited more often than their counterparts in basic science and other groups. Nevertheless, within each discipline grouping the general pattern of highest-to-lowest values from left to right of the page holds true. Table 16 shows the number of publications per year by decade of the investigator's age. To better visualize the trend, the same data are displayed in Figures 2 through 5. Although a slight decline in publication rate appears after age 60, the pattern for all groups is similar.

Tables 19 to 23 display the data by degree. Investigators with MD degrees publish significantly more papers that their PhD counterparts (Tables 20, 21); however, the total number of citations to the PhD group is almost the same as for the MD scientists. This indicates that there are, on average, more citations per publication for those with PhD degrees. Figures 6 and 7 are graphic representations of Table 21. The publication rate declines slightly after age 60, although that trend is a general characteristic of all groups.

Tables 24 to 30 display the data by discipline and degree. Because the counts per cell are low, the distinction among groups are often obscured by the large confidence interval ranges. Nevertheless, the general pattern is similar to the composite data pattern in previous tables, high-to-low values from left (K06APP) to right (K06REJ) of the page. This shows that no single sub-grouping by discipline and degree has an undue skewing effect on the overall observation of a high level of productivity of K06 awardees in comparison with all other groups.

The correlations between measured variables are shown in Table 31. There is a high correlation between the total number of publications per investigator and all other publication measures. The correlations are considerably lower for the relationship between total publications and the number of years of grant support, or the citation rate. However, all correlations are significant.

Table 9

Five-Number Summary of Measures of Productivity
(K06 Awardees)

Measured variables	Minimum	Lower quartile Q1	Median	Upper quartile Q3	Maximum
Age in 1964	34	42	46	50	65
Publication average Age 40-49	0.4	1.8	3.2	5.0	12.5
Publication average Age 50-59	0.3	1.4	2.7	4.4	20.4
Publication average Age 60 & above	0	1.4	2.3	3.6	14.5
Publication average All ages combined	0.3	1.4	2.5	4.2	19.1
Total number of publications	1	24	43	72	344
Years of publication activity	1	16	18	18	18
Years of R01 grant support	0	12	17	20	30
Number of citations in 1968	0	30	53	104	571
Number of citations in 1976	0	25	45	99	675
R01 grant priority highest score 1961-65	100	138	181	225	359

Table 10

Five-Number Summary of Measures of Productivity
(K06 disapproved applications)

Measured variables	Minimum	Lower quartile Q1	Median	Upper quartile Q3	Maximum
Age in 1964	35	43	46	53	67
Publication average Age 40-49	0	0.8	1.5	2.8	8.4
Publication average Age 50-59	0.1	0.6	1.4	2.7	6.5
Publication average Age 60 & above	0.2	0.6	1.3	2.3	6.1
Publication average All ages combined	0.2	0.8	1.2	2.3	7.3
Total number of publications	1	7	14	33	132
Years of publication activity	1	10	15	18	18
Years of R01 grant support	0	4	8	12	25
Number of citations in 1968	0	4	14	39	130
Number of citations in 1976	0	3	11	34	147
R01 grant priority highest score 1961-65	101	187	237	292	400

Table 11

Measures of Research Productivity by Group
Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Measures of productivity	K06APP	PR100	PR150	PR300	K06REJ
Publication average Age 40-49	3.0 (92)	2.0 (45) (1.5-2.5)	2.1 (96) (1.8-2.4)	1.3 (62) (1.0-1.7)	1.5 (25)
Publication average Age 50-59	2.6 (167)	2.2 (69) (1.8-2.7)	2.1 (112) (1.8-2.5)	1.5 (71) (1.3-1.9)	1.2 (51)
Publication average Age 60 & above	2.3 (90)	1.9 (46) (1.5-2.5)	2.3 (44) (1.8-2.9)	1.4 (22) (0.9-2.2)	1.1 (34)
Publication average All ages combined	2.5 (196)	1.9 (96) (1.6-2.2)	2.0 (153) (1.8-2.2)	1.5 (96) (1.3-1.7)	1.3 (72)
Total number of publication	37.0 (196)	23.6 (99) (18.6-29.8)	25.0 (154) (21.0-29.9)	17.5 (96) (13.8-22.1)	14.3 (72)
Years of publication activity	16.0 (196)	15.1 (96) (14.1-16.1)	14.4 (154) (13.6-15.2)	13.9 (96) (12.9-14.9)	12.9 (72)
Years of R01 grant support*	16.1 (227)	16.3 (124) (14.9-17.7)	13.9 (167) (13.0-24.9)	9.1 (108) (8.0-10.2)	8.4 (79)
Number of citations 1968	51.9 (211)	44.3 (123) (35.7-54.9)	25.8 (169) (21.6-30.8)	14.2 (108) (11.0-18.3)	14.3 (79)
Number of citations 1976	45.2 (211)	34.1 (123) (26.5-44.0)	27.4 (169) (22.5-33.3)	10.3 (108) (7.8-13.5)	13.2 (79)

*Arithmetic mean.

Table 12

Types of NIH Grants Awarded by Group

Number and percentage of each group receiving NIH awards by activity category. R01 and K06 grants were excluded since they were used in the group selection process.

Activity code	K06APP % (No.)	PR100 % (No.)	PR150 % (No.)	PR300 % (No.)	K06REJ % (No.)
TOTAL	100 (230)	100 (95)	100 (179)	100 (130)	100 (80)
T	49.6 (114)	37.9 (36)	20.7 (36)	23.8 (31)	16.3 (13)
P	23.5 (54)	16.8 (16)	10.6 (19)	5.4 (7)	1.3 (1)
R (excluding R01)	17.0 (39)	9.5 (9)	11.2 (20)	6.9 (9)	16.3 (13)
N	11.3 (26)	0	0	0	3.8 (3)
K (excluding K06)	5.7 (13)	7.4 (7)	7.8 (14)	6.9 (9)	7.5 (6)
M	4.3 (10)	2.1 (2)	1.1 (2)	0.8 (1)	0
S	4.3 (10)	9.5 (9)	4.5 (8)	3.8 (5)	3.8 (3)

T Training programs

P Research program projects and centers

R Research projects (traditional); R01s were excluded since 100% of each control groups had received R01 awards

N Research and research-related contracts

K Research Career Programs; K06s were excluded since 100% of K06APP groups had received K06 awards and all other groups received no K06 awards

M General Research Clinical Centers Program

S General support (research-related) programs

Other award categories are not listed because the numbers in each group by activity code were insufficient for comparison purposes

Table 13

Number of Citations by Discipline

Number of citations per individual in 1968 and 1976. Geometric mean (counts in brackets) and (95% confidence interval (in parentheses).

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences 1968	45 [60]	34 [44] (23-51)	24 [53] (17-33)	18 [24] (11-29)	10 [20]
Biochemistry 1968	61 [42]	71 [44] (50-99)	35 [51] (25-49)	15 [13] (7-29)	16 [15]
Medicine, Pediatrics, Pathology, 1968	58 [62]	25 [16] (14-46)	30 [29] (19-47)	17 (32) (12-25)	19 [20]
Other 1968	48 [46]	45 [17] (30-67)	16 [30] (11-23)	10 [32] (6-16)	14 [18]
Basic Sciences 1976	42 [60]	23 [44] (15-37)	26 [53] (20-35)	11 [22] (6-21)	10 [18]
Biochemistry 1976	52 [41]	66 [44] (46-94)	36 [53] (25-51)	11 [12] (5-23)	9 [15]
Medicine, Pediatrics, Pathology, 1976	49 [62]	22 [15] (13-37)	31 [29] (19-48)	12 [32] (8-20)	20 [18]
Other 1976	30 [47]	26 [18] (14-48)	16 [29] (11-24)	8 [35] (5-13)	15 [18]

Table 14

Number of Publications by Discipline

Total number of publications between 1965-1982. Geometric mean (counts in brackets) and (95%) confidence interval (in parentheses).

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences	34 (54)	21 (40) (15-30)	28 (50) (21-36)	15 (22) (9-23)	9 (18)
Biochemistry	48 (39)	36 (31) (23-58)	19 (50) (13-29)	18 (13) (11-30)	12 (14)
Medicine, Pediatrics, Pathology	53 (60)	21 (13) (12-35)	39 (29) (28-55)	27 (30) (19-37)	24 (21)
Other	20 (43)	15 (15) (9-26)	21 (25) (14-31)	13 (31) (8-21)	14 (19)

Table 15

Publication Rate by Discipline

Total number of papers/total years of publication activity. Geometric mean (counts in brackets) and 95% of confidence interval (in parentheses).

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences	2.2 (54)	1.6 (37) (1.2-2.1)	2.0 (49) (1.7-2.5)	1.4 (22) (1.0-2.0)	0.9 (18)
Biochemistry	3.1 (39)	2.9 (31) (2.2-3.7)	1.8 (50) (1.5-2.2)	1.3 (13) (1.0-2.0)	1.1 (14)
Medicine, Pediatrics, Pathology	3.2 (60)	1.5 (13) (1.1-2.2)	2.6 (29) (2.0-3.5)	1.7 (30) (1.2-2.2)	1.8 (21)
Other	1.7 (43)	1.3 (15) (1.0-1.8)	1.7 (25) (1.3-2.2)	1.4 (31) (1.0-1.8)	1.2 (19)

Table 16

Publication Rate by Age and Discipline

Publication rate (articles/year) ages 40-49, 50-59, and 60 and older. Geometric mean (counts in brackets) and 95% confidence interval (in parentheses).

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences Age 40-49	2.7 (28)	0.9 (17) (0.6-1.3)	2.0 (35) (1.6-2.6)	1.2 (15) (0.7-1.9)	---
Basic Sciences Age 50-59	2.1 (48)	1.6 (29) (0.9-2.6)	2.3 (37) (1.8-3.0)	1.5 (16) (1.0-2.4)	1.2 (10)
Basic Sciences Age 60-	2.3 (22)	1.5 (22) (0.8-2.8)	2.4 (13) (1.3-4.7)	---	0.6 (10)
Biochemistry Age 40-49	3.1 (20)	2.6 (16) (1.9-3.6)	1.7 (33) (1.2-2.2)	1.1 (9) (0.6-2.2)	---
Biochemistry Age 50-59	3.2 (33)	2.8 (20) (2.2-3.7)	1.5 (34) (1.1-2.1)	1.6 (9) (0.9-2.9)	1.1 (13)
Biochemistry Age 60-	2.7 (21)	2.2 (21) (1.4-3.4)	2.2 (10) (1.1-4.3)	---	1.3 (9)
Medicine, Pediatrics, Pathology Age 40-49	3.5 (32)	3.6 (6) (1.9-4.9)	2.8 (19) (2.1-3.9)	1.6 (22) (1.1-2.4)	2.4 (7)
Medicine, Pediatrics, Pathology Age 50-59	3.3 (53)	3.0 (9) (2.0-4.7)	2.8 (23) (2.0-3.9)	1.6 (25) (1.2-2.2)	1.6 (13)
Medicine, Pediatrics, Pathology Age 60-	2.8 (27)	1.9 (6) (1.1-3.5)	2.9 (8) (1.8-4.8)	1.2 (8) (0.5-2.8)	1.6 (11)
Other Age 40-49	2.6 (12)	1.6 (6) (0.9-2.7)	2.0 (9) (1.3-3.1)	1.2 (16) (0.8-1.9)	1.3 (11)
Other Age 50-59	1.7 (33)	1.6 (11) (1.1-2.3)	2.3 (17) (1.7-3.2)	1.4 (21) (0.9-2.2)	1.2 (15)
Other Age 60-	1.6 (19)	1.9 (6) (1.1-3.2)	1.9 (13) (1.4-2.6)	2.0 (8) (1.0-3.9)	1.5 (4)

Table 17

Number of Years of Publication Activity by Discipline (between 1965 and 1981)

Arithmetic mean (in brackets) and 95% confidence interval (in parentheses)

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences	16.0 (54)	14.9 (37) (12.9-16.8)	15.1 (49) (13.8-16.4)	12.6 (22) (10.2-15.0)	10.8 (18)
Biochemistry	16.4 (39)	15.5 (31) (13.7-17.2)	12.7 (51) (11.0-14.5)	14.7 (13) (12.9-16.5)	12.6 (14)
Medicine, Pediatrics, Pathology	16.8 (60)	15.1 (13) (13.1-17.0)	15.9 (29) (14.9-16.9)	16.5 (30) (15.5-17.5)	14.4 (21)
Other	14.4 (43)	14.9 (15) (12.5-17.2)	14.3 (25) (12.5-16.0)	12.0 (31) (9.9-14.0)	13.6 (19)

Table 18

Number of Years of NIH Research Grant (R01) Support by Discipline

Arithmetic mean (in brackets) and 95% confidence intervals (in parentheses)

Discipline	K06APP	PR100	PR150	PR300	K06REJ
Basic Sciences	15.6 (64)	14.3 (45) (11.4-17.1)	16.9 (54) (15.1-18.7)	9.4 (23) (7.0-11.9)	9.0 (20)
Biochemistry	16.8 (44)	19.1 (45) (17.0-21.1)	14.1 (52) (12.4-15.8)	11.9 (13) (7.6-16.2)	10.0 (16)
Medicine, Pediatrics, Pathology	17.1 (68)	15.3 (16) (12.8-17.8)	14.2 (28) (12.2-16.1)	8.9 (32) (7.0-10.9)	8.8 (21)
Other	13.5 (51)	13.9 (18) (10.5-17.3)	10.4 (33) (8.6-12.2)	8.1 (40) (16.4-9.8)	6.4 (22)

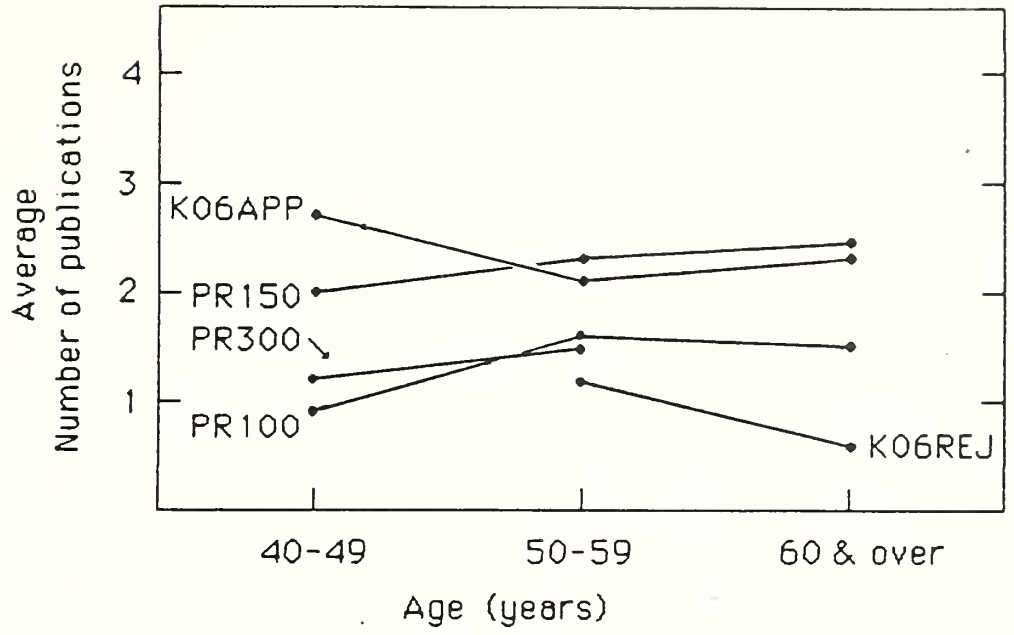

Figure 2. Basic sciences (except biochemistry): publication average (articles per year).

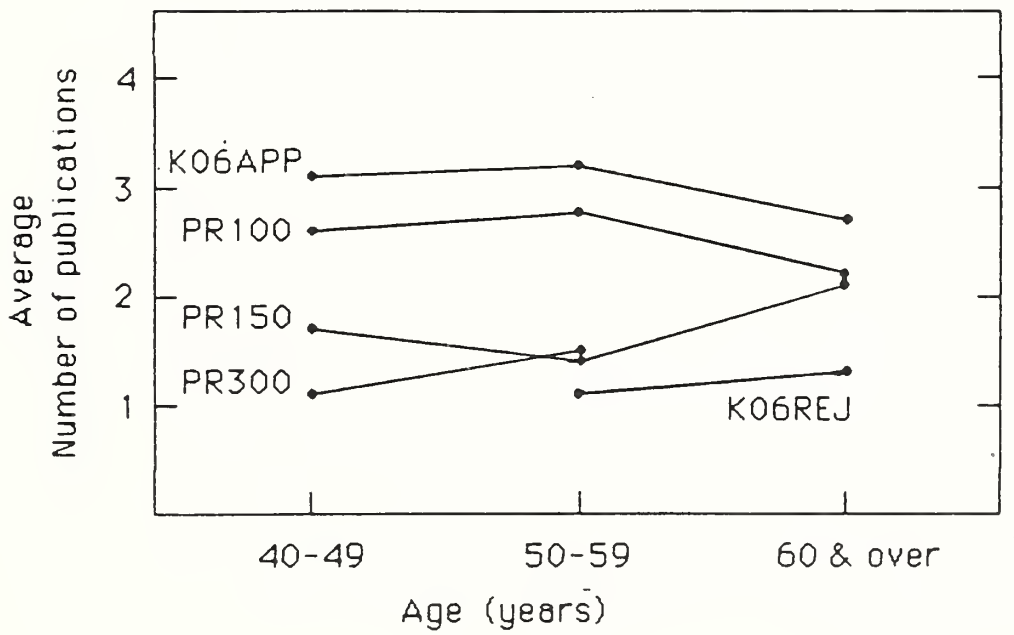

Figure 3. Biochemistry: publication average (articles per year).

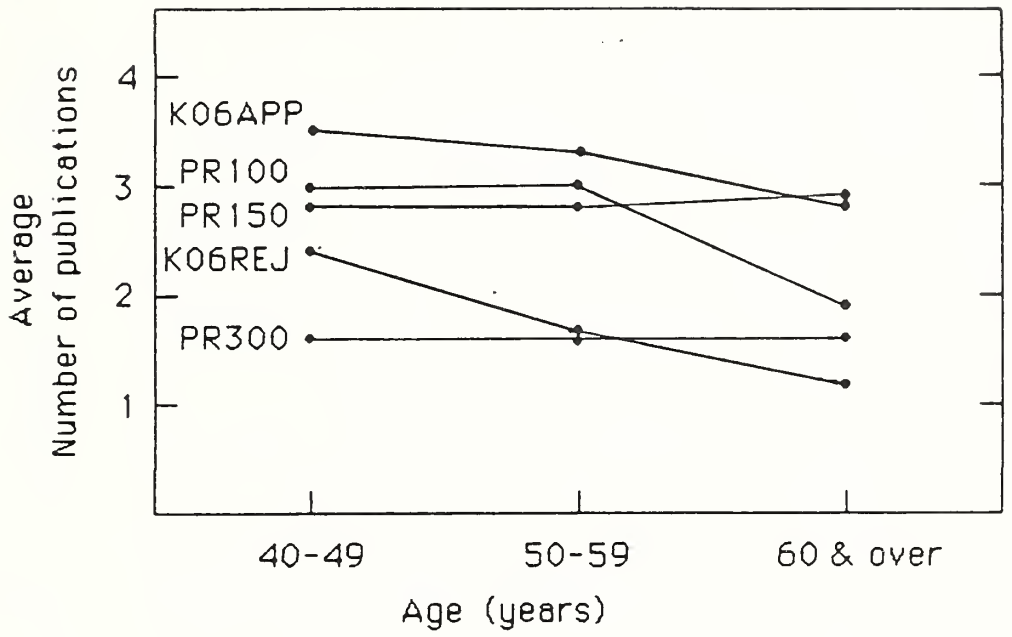

Figure 4. Medicine, pediatrics, pathology: publication averages (articles per year).

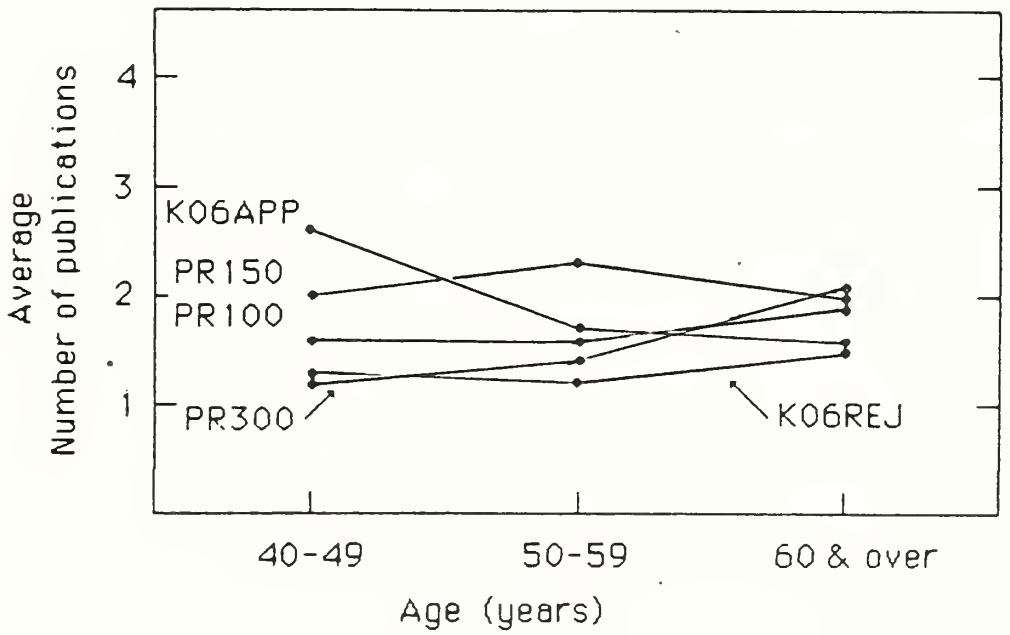

Figure 5. Others: publication averages (articles per year).

Table 19

Number of Citations per Individual by Degree in 1968 and 1976

Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD 1968	51 (102)	42 (56) (32-56)	26 (88) (20-33)	11 (47) (8-16)	13 (46)
MD 1968	55 (98)	49 (41) (32-73)	26 (49) (19-36)	18 (43) (13-25)	23 (17)
PhD 1976	44 (102)	33 (56) (24-47)	27 (89) (21-34)	8 (46) (5-11)	10 (45)
MD 1976	49 (98)	42 (40) (28-62)	30 (48) (22-42)	13 (44) (9-20)	26 (16)

Table 20

Number of Publications by Degree (between 1965 and 1982)

Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD	29.0 (95)	20.4 (43) (15.2-27.2)	17.9 (85) (14.1-22.8)	11.8 (44) (8.9-15.8)	9.3 (44)
MD	52.0 (91)	35.2 (35) (22.4-55.5)	43.3 (46) (34.6-54.3)	26.3 (42) (19.2-36.0)	33.2 (18)

Table 21

Publication Rate by Age and Degree (articles published/year)

Ages 40-49, 50-59, 60 and older, and composite average (total number of papers/total years of pulication activity). Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD 40-49	2.6 (42)	1.7 (22) (1.3-2.3)	1.7 (47) (1.4-2.0)	0.9 (27) (0.7-1.2)	0.9 (13)
PhD 50-59	2.1 (78)	1.9 (27) (1.5-2.5)	1.7 (57) (1.4-2.1)	1.2 (30) (1.0-1.6)	0.9 (31)
PhD 60-	2.1 (42)	1.4 (15) (1.0-2.0)	2.1 (22) (1.4-3.0)	1.0 (8) (0.6-1.7)	0.9 (20)
PhD Total	2.1 (95)	1.6 (45) (1.3-2.0)	1.6 (48) (1.4-1.9)	1.2 (44) (1.0-1.4)	1.0 (44)
MD 40-49	3.5 (47)	2.9 (10) (1.7-4.8)	2.9 (30) (2.2-3.8)	1.7 (30) (1.2-2.4)	3.0 (8)
MD 50-59	3.2 (82)	3.2 (26) (2.0-4.4)	2.9 (37) (2.2-3.7)	1.7 (34) (1.2-2.3)	1.8 (12)
MD 60-	2.6 (42)	2.8 (21) (1.8-4.3)	2.5 (15) (1.9-3.3)	1.5 (11) (0.8-3.0)	2.7 (9)
MD Total	3.1 (91)	2.6 (33) (1.9-3.6)	2.8 (46) (2.3-3.4)	1.8 (42) (1.4-2.3)	2.2 (18)

Table 22

Number of Years of Publication Activity by Degree
(between 1965 and 1982)

Arithmetic mean (counts in brackets) and 95% confidence intervals (in parentheses)

Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD	15.3 (95)	15.4 (43) (13.5-17.3)	13.5 (85) (11.8-15.1)	12.5 (44) (10.1-14.8)	11.5 (44)
MD	17.1 (91)	15.1 (35) (12.5-17.6)	16.0 (46) (14.6-17.3)	15.9 (42) (14.6-17.3)	15.7 (18)
MD-PhD	12.4 (7)	15.0 (8) (9.9-20.1)			15.1 (8)

Table 23

Number of Years of NIH Research Grant (R01) Support by Degree

Arithmetic mean (counts in brackets) and 95% confidence interval (in parentheses)

Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD	15.2 (105)	16.3 (57) (14.4-18.2)	13.7 (92) (12.5-14.9)	9.2 (50) (7.4-11.0)	8.3 (43)
MD	17.1 (103)	16.5 (42) (13.4-19.6)	14.8 (42) (12.2-17.3)	9.0 (46) (6.7-11.3)	10.1
MD-PhD	17.6 (8)	18.6 (9) (9.7-27.5)			6.3 (7)

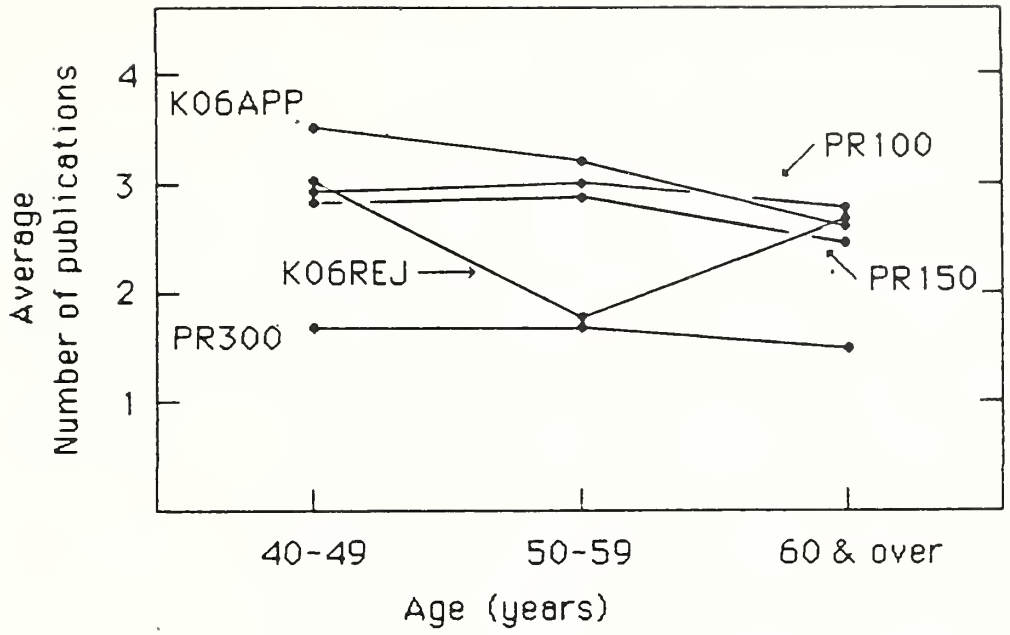

Figure 6. Scientists with PhD degrees: publication averages (articles per year).

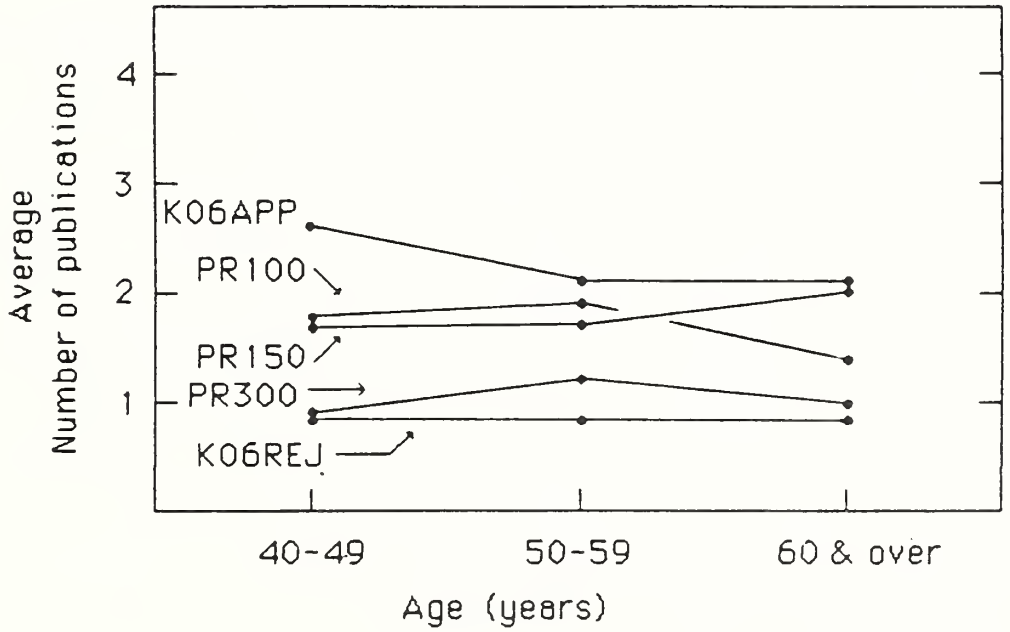

Figure 7. Scientists with MD degrees: publication averages (articles per year).

Table 24

Number of Citations per Individual by Degree and Discipline (in 1968 and 1976)

Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Discipline/Degree	K06APP	PR100	PR150	PR300	K06REJ
Basic science, PhD 1968	42 (53)	14 (16) (8-27)	26 (29) (18-38)	15 (19) (9-25)	10 (17)
Basic science, MD 1968	55 (20)	87 (7) (44-172)	31 (8) (13-72)	-	-
Biochemistry, PhD 1968	66 (36)	60 (44) (44-82)	39 (45) (27-55)	15 (13) (7-29)	20 (14)
Biochemistry, MD 1968	-	-	-	-	-
Medicine, Pediatrics, Pathology, PhD 1968	-	-	-	-	-
Medicine, Pediatrics, Pathology, MD 1968	57 (59)	35 (21) (20-60)	27 (33) (17-41)	17 (32) (12-25)	22 (14)
Other, PhD 1968	51 (30)	47 (17) (27-83)	10 (18) (6-18)	5 (15) (3-10)	13 (15)
Other, MD 1968	46 (16)	42 (6) (13-138)	22 (10) (13-38)	20 (11) (9-44)	-
Basic Science, PhD 1976	40 (35)	11 (15) (4-26)	24 (29) (16-35)	9 (17) (5-17)	10 (16)
Basic Science, MD 1976	57 (20)	45 (7) (23-88)	25 (8) (10-64)	-	-
Biochemistry, PhD 1976	52 (35)	52 (44) (37-75)	39 (47) (27-56)	11 (12) (5-23)	8 (14)
Biochemistry, MD 1976	-	-	-	-	-

Table 24 (Continued)

Discipline/Degree	K06APP	PR100	PR150	PR300	K06REJ
Medicine, Pediatrics, Pathology, PhD 1976	-	-	-	-	-
Medicine, Pediatrics, Pathology, MD	49 (59)	35 (20) (21-58)	33 (33) (21-50)	12 (32) (8-20)	24 (13)
Other, PhD 1976	39 (20)	28 (18) (14-58)	14 (22) (9-23)	5 (17) (3-9)	12 (15)
Other, MD 1976	39 (16)	36 (6) (9-145)	28 (12) (17-46)	15 (12) (6-39)	-

Table 25

Total number of Publications by Degree and Discipline (between 1965 and 1982)

Geometric mean [counts in brackets] and 95% confidence interval (in parentheses)

Discipline/Degree	K06APP	PR100	PR150	PR300	K06REJ
Basic science, PhD	33.7 [32]	15.4 [14] (10.5-22.7)	24.7 [29] (16.6-36.7)	13.1 [18] (9.0-19.2)	7.7 [16]
Basic science, MD	45.2 [17]	47.5 [6] (18.5-121.6)	28.8 [8] (18.5-45.0)	---	---
Biochemistry, PhD	48.9 [33]	26.8 [33] (17.5-41.1)	16.1 [45] (11.0-23.7)	18.4 [13] (11.3-30.1)	11.5 [13]
Biochemistry, MD	---	---	---	---	---
Medicine, Pediatrics, PhD Pathology	---	---	---	---	---
Medicine, Pediatrics, MD Pathology	55.4 [57]	31.4 [16] (18.0-54.7)	44.1 [33] (32.5-59.7)	26.8 [30] (19.4-37.1)	30.7 [15]
Other, PhD	12.7 [29]	14.5 [15] (7.9-26.5)	12.7 [18] (8.3-19.3)	6.6 [13] (3.8-37.1)	9.5 [15]
Other, MD	49.1 [14]	---	56.7 [10] (38.8-83.3)	25.1 [12] (11.6-54.2)	---

Table 26

Publication Rate by Age, Degree, and Discipline

Publication rate (articles published per year) ages 40-49, 50-59, 60 and older.
Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Basic Science/Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD 40-49	2.5 [18]	0.9 [7] (0.6-1.3)	2.2 [19] (1.6-2.9)	0.9 [12] (0.6-1.3)	---
PhD 50-59	2.1 [29]	1.1 [9] (0.8-1.5)	2.1 [22] (1.5-2.9)	1.3 [13] (0.9-1.9)	0.9 [8]
PhD 60-	2.1 [11]	0.9 [7] (0.4-1.9)	1.9 [7] (0.8-4.8)	---	0.9 [9]
PhD total	2.3 [32]	1.0 [14] (0.8-1.4)	1.9 [28] (1.4-2.5)	1.3 [18] (0.9-1.7)	0.8 [16]
MD 40-49	3.5 [8]	1.4 [9] (0.7-2.7)	1.4 [5] (0.7-3.1)	---	---
MD 50-59	2.5 [15]	2.8 [6] (1.0-7.9)	2.1 [6] (1.5-2.9)	---	---
MD 60-	2.2 [9]	3.1 [5] (1.5-6.5)	---	---	---
MD total	2.6 [17]	3.1 [6] (1.3-7.1)	2.2 [8] (1.6-3.1)	---	---

Table 27

Publication Rate by Age, Degree, and Discipline

Publication rate (articles published per year) ages 40-49, 50-59, 60 and older
Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Biochemistry/Degree	K06APP	PR100	PR150	PR300	K06REJ
PhD 40-49	3.0 (17)	2.6 (15) (1.8-3.7)	1.6 (28) (1.2-2.2)	1.1 (9) (0.6-2.2)	---
PhD 50-59	3.2 (29)	2.9 (22) (2.2-3.8)	1.5 (30) (1.1-2.1)	1.6 (9) (0.9-2.9)	1.1 (12)
PhD 60-	2.9 (17)	1.9 (13) (1.2-3.0)	2.2 (9) (1.1-4.3)	---	1.3 (8)
PhD total	3.2 (33)	2.1 (31) (1.6-2.8)	1.6 (45) (1.3-2.0)	1.3 (13) (0.8-2.0)	1.1 (13)

Insufficient data for MD.

Table 28

Publication Rate by Age, Degree, and Discipline

Publication rate (articles published per year) ages 40-49, 50-59, 60 and older
Geometric mean (counts in brackets) and 95% confidence interval (in parentheses)

Medicine, Pediatrics, Pathology/Degree	K06APP	PR100	PR150	PR300	K06REJ
MD 40-49	3.4 (33)	3.1 (8) (1.7-5.7)	3.0 (24) (2.2-40)	1.6 (22) (1.1-2.4)	3.1 (6)
MD 50-59	3.3 (52)	3.1 (11) (1.8-5.3)	2.8 (26) (2.0-4.0)	1.6 (25) (1.2-2.2)	1.6 (9)
MD 60-	2.6 (25)	1.7 (8) (0.9-3.2)	3.0 (7) (1.8-4.9)	1.2 (8) (0.5-2.8)	2.5 (8)
MD total	3.3 (57)	2.3 (16) (1.5-3.6)	2.8 (33) (2.2-3.7)	1.7 (30) (1.2-2.2)	2.1 (15)

Insufficient data for PhD.

Table 29

Number of Years of Publication Activity by Degree and Discipline
(between 1965 and 1982)

Arithmetic mean (counts in brackets) and 95% confidence interval
(in parentheses).

Discipline/Degree	K06APP	PR100	PR150	PR300	K06REJ
Basic science, PhD	15.5 (32)	15.4 (14) (12.6-18.2)	15.4 (28) (13.2-17.6)	12.4 (18) (8.5-16.2)	10.0 (18)
Basic science, MD	17.5 (17)	15.8 (6) (12.0-19.7)	14.3 (8) (9.0-19.5)	---	---
Biochemistry, PhD	16.6 (33)	15.8 (31) (13.2-18.4)	12.7 (46) (10.1-15.3)	14.7 (13) (11.9-17.4)	12.2 (13)
Biochemistry, MD	---	---	---	---	---
Medicine, PhD	---	---	---	---	---
Medicine, MD	17.1 (57)	14.6 (16) (11.3-18.0)	15.9 (33) (14.3-17.5)	16.5 (30) (15.1-17.9)	15.4 (15)
Other, PhD	13.5 (29)	14.4 (14) (9.4-19.3)	11.9 (18) (8.1-15.7)	10.3 (13) (5.5-15.1)	12.5 (15)
Other, MD	16.4 (14)	---	17.4 (10) (16.5-18.3)	14.3 (12) (9.6-18.9)	---

Table 30

Number of Years of NIH Research Grant (R01) Support

Arithmetic mean [counts in brackets] and 95% confidence interval (in parentheses)

Discipline/Degree	K06APP	PR100	PR150	PR300	K06REJ
Basic science, PhD	15.7 [38]	12.3 [16] (6.9-17.8)	16.5 [31] (13.7-19.3)	8.8 [18] (4.9-12.8)	9.2 [15]
Basic science, MD	18.8 [20]	18.6 [7] (12.4-24.7)	18.2 [9] (10.7-26.0)	---	---
Biochemistry, PhD	16.5 [37]	19.2 [44] (15.7-22.6)	14.1 [47] (11.5-16.7)	11.9 [13] (5.7-18.4)	10.0 [15] ---
Biochemistry, MD	---	---	---	---	---
Medicine, PhD	---	---	---	---	---
Medicine, MD	17.1 [64]	15.0 [21] (11.0-19.1)	14.5 [33] (11.4-17.5)	8.6 [32] (60.0-11.8)	10.4 [15]
Other, PhD	13.2 [34]	12.8 [18] (6.6-18.9)	9.3 [23] (6.1-12.6)	7.7 [19] (3.8-11.7)	6.0 [18]
Other, MD	14.2 [17]	17.7 [6] (6.5-28.8)	13.0 [12] (8.3-17.9)	9.2 [14] (5.4-13.1)	

Table 31

Correlations with Total Number of Publications

Pearson's correlation coefficient (counts in brackets)

Variable	All groups	K06APP	PR100	PR150	PR300	K06REJ
Publications Age 40-49	0.87 (320)	0.80 (92)	0.85 (45)	0.89 (96)	0.97 (62)	0.91 (25)
Publications Age 50-59	0.95 (470)	0.95 (167)	0.95 (69)	0.94 (112)	0.94 (71)	0.91 (51)
Publications Age 60 & over	0.91 (236)	0.93 (90)	0.85 (46)	0.90 (44)	0.96 (22)	0.93 (34)
Average number of publications per year	0.98 (613)	0.99 (196)	0.96 (96)	0.98 (153)	0.98 (96)	0.95 (72)
Years of publication	0.47 (613)	0.42 (196)	0.46 (96)	0.48 (153)	0.44 (96)	0.59 (72)
Years of R01 grant support	0.34 (609)	0.24 (193)	0.48 (99)	0.29 (151)	0.14 (95)	0.32 (71)
Number of citations 1968	0.34 (613)	0.26 (194)	0.34 (99)	0.29 (153)	0.45 (96)	0.36 (71)
Number of citations 1976	0.43 (613)	0.48 (194)	0.20 (99)	0.35 (153)	0.71 (96)	0.54 (71)

DISCUSSION

This study was undertaken, in part, because any discussion of funding proposals involving salary support seems inevitably to make reference to the Research Career Award (K06) "experience." This study was not undertaken on the premise that the K06 program be resurrected. However, an assessment of the program within the historical context may prove relevant to future manpower planning.

From its inception, the goals of the Research Career program ha have been misunderstood by many members of the biomedical community. The intent of Congress was clear, i.e., to add 200 stable positions to this nation's pool of biomedical scientists, but some administrators and scientists at univerities and even some high-level officials at the National Institutes of Health (NIH) perceived the award as a prize for excellence in research. In retrospect, this perception is somewhat puzzling in the face of application guidelines which gave preference to individuals 45 years of age and younger, those depending on unstable sources of salary support, and those who would benefit from a reduction in their administrative or clinical workload to allow more time for research. Although the guidelines were not binding, it seems reasonable to suppose that they had a major impact on the institutional nomination process. For example, most institutions nominated distinguished faculty nearing retirement age for the short-lived Research Professorship Award, but after the guidelines were revised the average age of the recipients of the Research Career Award was 45 years. This alone indicates that a number of older scientists with distinguished achievement records were never nominated.

It is more difficult to ascertain whether or not preference was actually given to candidates in need of salary stabilization or a reduction in administra-

tive duties. However, in an informal poll taken by the NIH Training Office in November 1963, the individual Institutes of the NIH were asked to list the number of awardees for whom salary source or change in duties was a consideration in the selection process. Table 32 presents the response distribution. Although it was assumed that all awards were for excellence, some institutes apparently interpreted the question to mean that preference given for reasons other than excellence would be an admission that the standards had been compromised. This inference that the choices were mutually exclusive probably led to some underreporting. Nevertheless, of the 198 awards that had been made by late 1963 at least 42% (48 unstable support, 35 change in duties) were made with the above stipulations in mind.

Thus, K06 was not a prize, but was intended to finance additional stable positions for investigators who were continuing to develop in productive careers of independent research and teaching. In fact, many distinguished scientists were never nominated, not only for the above considerations but because some of them held administrative titles (e.g., chairmen). Others declined to apply because of loss of current or prospective income. Finally, a few institutions submitted no nominations because they believed the Federal government was intruding into employment policies of the university.

A second misconception was the belief that two nominees who later received Nobel prizes had been rejected by the K06 selection process. These individuals were not rejected by the review process but were among the 117 applications administratively withdrawn prior to initial review. Very little information is available on specific reasons for these administrative actions but accessible data suggest that most of these 117 candidates met the criteria of excellence. Several nominees were deemed ineligible because they held administrative titles,

Table 32*

Award Criteria

Institute	Total awards	Principal reason for award		
		Unstable support	Significant change	Excellence
All	198	48	35	105
AI	27	-	-	27
AM	40	22	16	2
CA	15	5	5	5
DE	-	-	-	-
GM	42	-	-	42
HD	-	-	-	-
HL	32	1	3	28
MH	19	11	5	3
NS	16	9	6	1

*Internal memo from Office of Institutional Relations, NIH, 1984.

and at least one applicant withdrew because of a reduction in total compensation. Thus, administrative withdrawal did not imply lack of research potential.

A third misconception revolves around the issue of productivity, perceived by some to be less for K06 awardees compared to a select group of other investigators not receiving K06 support. In part, this perception stems from a misunderstanding of the program goals and the selection process already

discussed. The a priori expectation, because of the guideline priorities and constraints, was that the awardee group would be less productive than some others. Thus it is interesting to find in this study that the K06 group performed at least as well and generally better than the "best" comparison group.

The comparison groups were selected on the basis of priority scores received on regular research grant (R01) applications between 1961 and 1965. The rationale for grouping indivuals by priority score is based on the fact that peer review groups are composed of "outside" experts and their collective judgment, the priority score, encompasses an evaluation of the investigator's potential to carry out the stated research aims. The comparison groups chosen received priority scores of 100 to 149 (PR100), 150 to 199 (PR150), and 300 to 349 (PR300); ranges of scores that generally reflect the very best, a slight cut below the best, and slightly below average, respectively. In this study, the rank order of performance was PR100 > PR150 > PR300 although the distinction between PR 100 and PR 150 was significant for only the 1968 citation counts. Nevertheless, it is remarkable that a single priority score during a five-year window is "predictive" of performance over the next 20 years of an investigator's research career. This has important implications for future funding considerations, and a more detailed study aimed at quantifying the predictive power of priority scores is required.

If the level of research productivity as measured by publications, citations, and years of research grant support are correlated with priority scores as this study suggests, it is surprising that the K06 group did so well. Since the average R01 priority score for the awardee group was 186 ± 60 (mean ± S.D.), their performance level was well above expectations. The reason for this

apparent discrepancy is not known but there may be factors in the selection process that could not be identified in this type of analysis. It seems more plausible, however, that the award provided a degree of security and relief from other duties which allowed for more research time and thus a higher level of productivity. As a group, the K06 awardees were remarkably successful in all measures of research output analyzed in this study.

It is of interest to note the differences in performance characteristics of subgroupings based on discipline (departmental affiliation) and degree (PhD vs MD). Publication and citation rates are generally higher for biochemists than for those in the other basic science disciplines; and the medicine, pediatrics, pathology group outperformed other medical specialists included in the other group. Nevertheless, within each category the general pattern K06AP > PR100 or PR150 > PR300 or K06REJ, was maintained. Those with MD degrees published more articles than those with PhD degrees, but, as above, within each degree category the publication rate was K06APP > PR100 or PR150 > PR300 or K06REJ. However, the citation rates for MD and PhD scientists were similar; thus, with fewer publications, those with PhD degrees have more citations per publication. This apparent discrepancy may be related to the fact that some of the publications by MD investigators are case reports that generally receive few citations.

From the very beginning of the K06 program, concern was expressed that the award would become a sinecure with a concomitant decline in research productivity. Although in this study, the publication rate seems to decline slightly after age 60, this decline was not significant, and, more important, a similar pattern was evident in all groups. Thus, the downward trend, if real, cannot be attributed to the receiving of a lifetime award.

Another finding is that the K06 recipients were awarded more grants of every type than any other group (see Table 12). In particular, the fact that 50% of the K06 group became principal investigators on training grants fulfills another major aim of the K06 award, research training.

Finally, it was somewhat surprising to find a low, albeit significant, correlation among the major end points in this study (see Table 31). For example, the total number of publications is correlated with citation counts in 1968: r = 0.34, which means that less than 10% of the citation rate can be ascribed to an effect of the number of publications. Thus, no single measure gives an accurate picture of overall achievement. Although, the results of the present study are unambiguous it may be worthwhile to obtain additional information on other career measures such as awards and honors received, number of graduate students and postdoctoral fellows, invited papers, editorships, etc. Although this would entail the use of questionnaires, the information gathered would serve two purposes. It would 1) provide a more comprehensive picture of the K06 and control groups, and 2) provide a series of "bench marks" of achievement to serve as points of reference for future generations of individuals embarking on a career in biomedical research.

APPENDIX

NATIONAL INSTITUTES OF HEALTH

Bethesda 14, Maryland

INFORMATION AND POLICY STATEMENT

on

RESEARCH CAREER AWARD PROGRAM

July 24, 1961

(Merges and Modifies the Career Research Professorship, Senior Fellowship Grant, and Special Fellowship Grant Programs)

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

RESEARCH CAREER AWARD PROGRAM

I. Purpose

Research Career Awards are available to institutions in the United States on behalf of qualified candidates to provide increased numbers of stable career opportunities for scientists of superior potential and capability in the sciences related to health. Awards are intended to provide individuals with some measure of assured support reasonably early in their careers. Two groups of awards are available as follows:

A. Research Career Awards Awards in this group are intended to finance additional stable positions for experienced investigators who are continuing to develop in productive careers of independent research and teaching. Awards are made on the basis of nationwide competition, and the research standards expected of candidates are high.

B. Research Career Development Awards Awards in this group are intended to finance positions for able scientists who plan to pursue careers in independent research and teaching. These awards are for young investigators who desire experience and further training in a productive research environment as well as for scientists undertaking independent research who need further experience to qualify for senior positions.

II. Terms of Awards

A. Responsibilities of Awardees and Institutions

Each awardee is directly responsible to his grantee institution, and his status, title and privileges (including official or sabbatical leave) will be determined by the institution according to its established policies. Although awardees may participate in teaching and other staff functions in their institutions, such activities must not deter them from devoting themselves substantially to research and research training.

B. Duration

Research Career Development Awards may be made for initial periods of five years and may be renewed upon adequate justification to provide a total period of support to an individual of not more than ten years. Recipients of these awards may be nominated for consideration for Research Career Awards at any appropriate time.

Research Career Awards are made in five-year increments with review at appropriate intervals to ensure that the award continues to promote the objectives of the program. Action will be taken on extension two years before the end of each five-year increment. Awards are made with the firm intention to continue Federal support for the full career of the individual provided 1) the recipient continues to meet the standards set by the institution for scientists with substantial responsibilities for research and research training, and 2) the institution and the scientist wish to have the award continued.

C. Salary

1. Amount The sponsoring institution should propose annual salary levels, including anticipated periodic increases, for the five-year period. The proposed salary levels should be based on the candidate's training, experience, and accomplishments, but may not exceed $25,000 per year. In addition to this base salary, fringe benefits paid by the institution and available to all faculty members (such as Social Security and retirement costs) may be included. Within these limits any salary proposed should be consistent with the established salary structure in operation at the institution. The application must, therefore, explain the relationship of the proposed salary, including anticipated periodic increases, to the salaries of other persons with similar positions and qualifications in the department or institution. Any unanticipated salary increase requested from the National Institutes of Health above those awarded will require an application for supplemental funds clearly justifying the need for

increase. The awardee may not receive income from the institution in addition to the amount provided through the award.

2. Full Time Since awards are intended to compensate recipients adequately for full-time positions it is expected that they will spend only minor portions of their time in activities other than research and teaching. It is understood that awardees will not engage for remuneration in clinical or other work such as the income-producing activities of faculty members in medical schools on "geographical full time." Within these general guidelines and within the policies of the sponsoring institution, recipients may accept incidental honoraria, royalties, and fees from such activities as writing, service on advisory groups, and occasional outside lectures.

Awardees may engage in the practice of their professions, including consultation, to the extent required by their research or teaching, or to maintain professional skills, but they may not retain personal income from the practice of their professions and may not be reimbursed by the institution for such practice. If it is proposed that the applicant institution or any other third party retain fees generated through the practice by a candidate of his profession, the full circumstances and facts relating to the fees will be taken into account on an individual basis in determining the conditions of the award.

D. Research Support of Candidates

A corollary application to meet the research needs of the candidate may be submitted to the Public Health Service or any other appropriate source.

III. Eligibility of Candidates

A. Qualifying Experience

Research Career Development Award The candidate must have had at least three years of relevant research or professional experience following the doctoral degree. The candidate must have demonstrated promise for a career in independent research.

Research Career Award The candidate must have demonstrated an ability to pursue a career in independent research and his research must have won the respect of scientific leaders in his field.

B. Age at Time of Initial Award

It is expected that the initial award will be made to most candidates before they are 45 years of age.

C. Citizenship

The candidate must be a citizen of the United States or have filed a Declaration of Intent.

D. Field of Research

The candidate must propose to engage in research in the sciences related to health.

E. Nomination by Institution

Candidates must be nominated by a public or private nonprofit institution engaged in research in the sciences related to health.

F. Stability of the Candidate's Current Source of Support

Since one of the purposes of the program is to create additional stable research

positions, preference will be given to candidates who at the time of application have incomes derived primarily from research grants or contracts and similar sources of relatively short assured duration.

IV. Institutional Obligations

A. Career Plans

The application for an Award requires a statement by the candidate of his research and teaching plans and a statement by the institution of its plans for the candidate's career with the institution.

B. Institutional Commitment to Career Investigators

It is expected that each candidate for a Research Career Award will be of such quality that the institution would wish to assure him a continuing position and salary whether or not the Federal award were available. The application should state this assurance, within the financial and legal capacity of the institution to make future commitments. The assurance would be based on the assumption that the candidate would continue to meet the standards of the institution for its research scientists. Public Health Service grants, including the General Research Support Grant, may be used to pay the salary of an awardee in the event other funds are not available to continue the Research Career Award.

V. Other Conditions

A. Application Form

Applications for these awards should be submitted on Form PHS-2557.(Revised July 1961)

B. Number of Applications per Institution

In any year, a maximum of four applications for Research Career Awards will be accepted from an institution (i.e., four from each medical school, dental school, graduate school, etc.)

There is no limitation on the number of applications for Research Career Development Awards which may be submitted by an institution.

C. Timing of Applications and Awards

Applications received by May 1 will be reviewed at the November Council meetings; those received by September 1 will be reviewed at the March meetings. Awards may be activated on the first day of any month within one year of the date of the award.

D. Transfer

Awards made under this program may not be transferred from one institution to another. When an awardee moves to a new institution, the award will end for both the institution and the individual.

E. Termination

If the grantee institution or the awardee elects to terminate the award for any reason, the National Institutes of Health should be notified and the date of termination stated.

PPO #29
POLICY
January 31, 1963

MEMORANDUM

TO : Public Health Service Extramural Staff

SUBJECT : Policies Governing the Research Program of the National Institutes of Health

EFFECTIVE DATE: January 1, 1963

Changes in policy for the Research Career Program are reflected in the new pamphlet, copy of which is attached. Attention is called particularly to the new requirement of a progress report and a separate expenditure report and to the fact that, effective January 1, 1963, payments of the balance due on a continuation grant will be withheld if the annual expenditure report is not received within three months after termination of the previous grant year and if it has not been accepted.

The Career Development Review Branch, DRG, will send directly a copy of the new policy statement of January 1, 1963, to every individual who received an RCP award from FY 1962 funds of the NIH and to the sponsor of each awardee. DGMS and the awarding Institutes are herewith requested to see that every individual receiving an RCP award from FY 1963 funds and each of their sponsors receive a copy of the new policy statement. The Internal Operations Branch of DRG will incorporate the new policy statement in the RCP application kits.

ORIGINATING OFFICE: Career Development Review Branch, DRG

POLICIES GOVERNING THE RESEARCH CAREER PROGRAM

OF THE

NATIONAL INSTITUTES OF HEALTH

January 1, 1963

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

National Institutes of Health

January 1, 1963

POLICIES GOVERNING THE RESEARCH CAREER PROGRAM OF THE NATIONAL INSTITUTES OF HEALTH

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Appendix

POLICIES GOVERNING THE RESEARCH CAREER PROGRAM OF THE NATIONAL INSTITUTES OF HEALTH 1/ 2/

I. Purpose

The purpose of the research career program is to increase the number of stable full-time career opportunities for scientists of superior potential and capability in the sciences related to health. Grants are made to public and private nonprofit institutions in the United States on behalf of qualified candidates. The program enables these institutions to establish stable positions for investigators reasonably early in their careers. Two categories of awards are available: Career awards and development awards.

A. Career awards

Career awards enable institutions to finance positions favorable to the intellectual growth and research productivity of established investigators of high competence for the duration of their careers. Awards are made on the basis of nationwide competition among candidates whose research has won the respect of scientific leaders in their fields.

B. Development awards

Development awards enable institutions to finance positions for qualified scientists who have three years or more of relevant postdoctoral research or professional experience.

Development awards are available to two groups:

Group I development awards are available for individuals with clear research potential who require additional training and experience in a productive scientific environment in preparation for careers in independent research;

Group II development awards are available for individuals with demonstrated capacity for independent research who have not yet reached the stage in their scientific development to qualify as candidates for career awards.

1/ This statement supersedes the NIH statement, dated July 24, 1961, entitled "Information and Policy Statement on Research Career Award Program." The effective date of this revised statement is January 1, 1963.

2/ This program is administered under authority of the Public Health Service Act of 1944, as amended, and Parts 1 and 61 of the Public Health Service Regulations (Code of Federal Regulations, Title 42, Parts 1 and 61) and Parts 6 and 8 of the Department of Health, Education, and Welfare Regulations (Code of Federal Regulations, Title 45, Parts 6 and 8).

All candidates will be evaluated in nationwide competition with other candidates of comparable training and experience.

II. Terms of awards

A. Responsibilities of awardees and institutions

Each awardee is directly responsible to the institution to which the award is made and his status, title, salary, and staff privileges (including official, sick, or sabbatical leave) will be determined by the institution according to its established policies within the limitations of the guidelines which follow. The number of years of service required by the institution before the individual is eligible for sabbatical leave must, however, be served by the research career program awardee during tenure of the research career program award. Or if the required years of service have not been so served, then the ratio between the salary paid from research career program funds and the salary permissible under the institution's sabbatical salary policy must be the same as the ratio between the number of years served under the research career program award to the number of years of service required by the institution for eligibility for sabbatical leave. Any overage in research career program funds must be remitted to PHS. A research career program awardee is, however, permitted to seek such supplementation through Federal or other sources as will bring his salary for the sabbatical period up to the level which he would have received under the research career program award, had he not planned on sabbatical leave.

Although an awardee may participate in teaching or other appropriate functions of his institution, his primary responsibilities must be for the conduct and direction of research and research training. Awards will not be made on behalf of persons who will have substantial administrative responsibilities. Nor will awards be continued or renewed if substantial administrative responsibilities are later assumed.

B. Duration

Development awards will be made annually to institutions for a five-year period only. They may be renewed upon adequate justification to enable institutions to provide a total period of career development support to an individual of not more than ten years. The grantee institution may nominate a development awardee for a career award at any appropriate time without jeopardizing the existing development award.

Career awards will enable institutions to provide salaries for the duration of the careers of awardees. Each award is made with the firm intention to continue Federal support annually for the full career of the individual provided (1) that he continues to meet the standards set by the institution for scientists with similar responsibilities, (2) that he and the institution wish to have the award continued, and (3) that he continues to devote himself to a career of research in accord with the purposes of the research career program. To ensure that the activities of the awardee continue to be in accord with the purposes of the program, his activities will be reviewed periodically. Awards will be made in five-year increments.

Within the five-year period, requests for continuation will be reviewed annually and action will be taken on renewal two years before the end of each five-year increment.

As in other NIH extramural programs, continuation of the awards is contingent upon the adequacy of future Federal appropriations

C. Requirement of full time in research and related activities

Since awards are intended to provide institutions with funds to compensate awardees adequately for full-time research and related activities, awardees should not engage in clinical practice, professional consultation, or similar work, except insofar as these activities are required by their research and teaching, or are necessary to maintain their professional skills. They may, however, engage in such activities as scholarly writing, service on advisory groups, and delivery of outside lectures, provided these activities remain incidental, and provided they are undertaken within institutional policy. To be acceptable, a candidate must agree to limit his activities in accordance with these policies.

D. Salary and other income

1. Allowable sources of income

The National Institutes of Health require that institutions use the award to provide full salary for the awardee. Accordingly (except for a sabbatical leave salary paid under the criteria stated in topic II-A, page 2), the awardee may not receive additional income for professional services from the institution or from other sources. He may, however, retain honoraria, royalties, and fees for such activities as scholarly writing, service on advisory groups, and delivery of outside lectures, provided that these activities remain incidental and are undertaken within institutional policy.

2. Determination of amount of salary

In the application, the sponsoring institution must indicate the salary it proposes to pay the candidate during the initial year. The salary should be based on the candidate's training, experience, and accomplishments, but may not exceed $25,000 per calendar year.

The salary proposed should be based on a full-time, 12-month staff appointment. It must be consistent both with the established salary structure at the institution and with salaries actually provided by the institution from its own funds to other staff members of equivalent qualifications, rank, and responsibilities in the department concerned. If full-time salaries are not currently paid to comparable staff members, the salary proposed must be appropriately related to the existing part-time salary structure. The institution should provide, in the application, information concerning the way in which the amount of the proposed salary was derived, including a statement of the relevant parts of the salary structure and examples of salaries being paid to comparable staff members.

3. Salary in subsequent years

For each subsequent year, the institution will file an application for continuation of the award, indicating the salary proposed to be paid from the grant. These proposed salaries should conform with the guidelines stated above. Any salary increase requested must be justified.

E. Other allowable costs

1. Fringe benefits

In addition to the base salary, the institution's share of contributions to finance such fringe benefits as are available to all other staff members of comparable rank and seniority at the institution under formally established and consistently applied institutional policies may be paid from award funds to the extent that they are consistently treated by the institution as direct rather than indirect costs. The employee's share must be deducted from his gross salary.

2. Indirect costs

An allowance for indirect costs is made to the grantee institution, if requested. The method of computing the allowance is shown in the instructions on the application form (Form PHS-2557).

F. Disposition of professional fees

If it is proposed that the applicant institution or other party retain fees accruing from professional practice by a candidate, the full circumstances and facts relating to the fees, and the policy of the institution relating thereto, must be presented in the application.

III. Eligibility of candidates

A. Career prospects at time of initial award

Only candidates who appear to have a substantial number of years of productive research ahead of them should be nominated.

B. Citizenship

The candidate for an initial award must be a citizen of the United States or must, at least one year prior to signing the application for a research career program award, have been lawfully admitted to the United States for permanent residence. Evidence of such admittance to the United States should be submitted with the application for the initial award. Such noncitizens will have their awards renewed beyond the total period initially recommended only if they have filed with NIH evidence of having become United States citizens.

To authenticate either lawful admittance for permanent residence or having become a United States citizen, the candidate should request the Immigration and Naturalization Service to furnish the necessary information to the sponsoring institution. This should be done by completing and filing with the Immigration and Naturalization Service that Service's Form N-585, "Application for Information from or Copies of Immigration and Naturalization Records." This form may be obtained from and should be filed with any I&NS field office, but preferably the one nearest the candidate's place of residence. In filling out Form N-585, the necessity of this information for an NIH award should be emphasized. Upon proper filing of the form, the Immigration and Naturalization Service will issue a statement regarding the candidate's lawful admission for permanent residence or citizenship, as the case may be, and will forward it directly to the sponsoring institution. To assure proper disposition of the statement, Form N-585 should clearly reflect the name and address of the sponsoring institution. The statement furnished by the Immigration and Naturalization Service should be included among the documents submitted by the sponsoring institution as application for the award.

C. Statement of allegiance

Generally, candidates must submit to NIH, prior to award, a written statement of allegiance to the United States.

D. Field of research

The candidate must propose to engage in research in the sciences related to health.

E. Nomination by institution

Candidates may be nominated by any nonfederal public or private nonprofit institution engaged in research in the sciences related to health.

F. Stability of the candidate's current source of support

Since the primary purpose of the program is to enable institutions to provide additional stable full-time research positions, preference will be given to candidates who have incomes derived primarily from research grants, contracts, or similar sources of relatively short assured duration, and to candidates for whom an award would permit a significant change in activities leading to essentially full-time research and training for research or essentially full-time research together with direction of research training.

IV. Institutional obligations

A. Career plans

In the application, the candidate must state his plans for research and other professional activities, and the institution must state its plans for the candidate's career, including training opportunities for the candidate when relevant.

B. Institutional commitment

It is expected that each candidate nominated for consideration at the level of a career award will be of such quality that the institution would wish to assure him a continuing position whether or not the career award were available. The application should contain a statement of this assurance within the financial and legal capacity of the institution to make future commitments.

V. Other conditions

A. Application form

Applications for initial awards should be submitted on Form PHS-2557, revised on or after January 1963. Forms for yearly continuation of previously recommended support will be mailed to each sponsoring institution at the appropriate time.

B. Timing of applications

Applications should be received by the Division of Research Grants, NIH, by May 1 for final review by the following December 1 or by September 1 for final review by the following April 1.

C. Number of applications per institution

In any 12-month period ending with the September 1 closing date, a maximum of four applications for career awards will be accepted from an institution (i.e., four from each medical school, dental school, graduate school, independent research institute, etc.). No limit is placed on the number of applications which may be submitted for development awards.

D. Use of PHS research or training grant funds freed by the research career program award

If immediately prior to the research career program award, the awardee's salary was paid in whole or in part from a PHS research or training grant, the grantee institution may not retain the latter funds for other research or training purposes without prior PHS approval of a supplemental application submitted under the program which formerly paid the awardee's salary.

E. Progress and expenditure reports

The grantee institution must submit each year, as part of the application for continuation, a statement summarizing the awardee's research and teaching activities and the extent and nature of his other activities such as administration, service on advisory groups, outside lectures, and professional practice and consultation.

In addition, an expenditure report, signed by both the head of the sponsoring department or departmental subdivision and the financial officer,

is required from the grantee institution within three months after termination of the grant year. The appropriate expenditure report form will be sent to the grantee institution prior to the close of the grant year. Effective January 1, 1963, payments of the balance due on a continuation grant will be withheld if the annual report of expenditures has not been received within three months after termination of the previous grant year and has not been accepted.

F. Transfer

Awards made under this program may not be transferred from one institution to another. When an awardee moves to a new institution, the award will end for both the former sponsoring institution and the individual. The new institution may, if it chooses, apply on behalf of the individual for another award.

G. Research support

Awardees are free to apply to any appropriate source for support of their research activities.

H. Termination

If either the grantee institution or the awardee elects to terminate the award for any reason, the National Institutes of Health must be notified of the date of and reason for termination. The Surgeon General will discontinue an award upon determination that the awardee is unable to carry out the purpose of the award or that the terms of the award are not being fulfilled.

I. Patents

This policy is described in the Appendix to this statement.

J. Publications and public presentations

Awardees are free to publish results of their work that is supported under the research career program. They and their institutions are equally free to disseminate such results through public communication media. The Public Health Service does not review proposed publications. Since no prior approval is required, responsibility for direction of the work published or presented should not be ascribed to PHS. Where there is publicity, however, PHS support must be acknowledged. For the sake of uniformity, the following footnote is suggested:

> "This investigation was supported (in part) by a Public Health Service research career program award (number ____) from the (Institute)."

Two copies of each such publication should be sent to the awarding NIH Institute. In presentations through other public communication media, PHS support may be mentioned, if desired.

VI. Privileged nature of information

The regulations of the PHS prohibit the disclosure of information obtained by the Service in connection with research career program applications except with the consent of the person concerned, or as may be directed by a court, or as necessary for performance of the functions of the Service.

VII. Federal taxability of salaries

Salaries paid to awardees for services rendered by virtue of their employment by the grantee institution are subject to deductions for fringe benefits such as social security and are also subject to the withholding tax provision of the Internal Revenue Code.

The above principles regarding Federal tax considerations are general guidelines. NIH takes no position and assumes no responsibility regarding the tax status of individuals receiving funds in any form under its extramural grant and award programs. Any questions on tax status should be directed to the local office of the Internal Revenue Service.

Appendix
January 1, 1963

Policy of the Public Health Service on Patents as Applied to the Research Career Program of the National Institutes of Health

I. Formal reports of inventions

Department of Health, Education, and Welfare regulations (45 CFR Parts 6 and 8) provide that all inventions arising out of the activities assisted by Public Health Service grants and awards shall be promptly and fully reported to the Surgeon General. In respect to inventions reported, the institution and the awardee agree either: (1) to refer the inventions to the Surgeon General for determination, in accordance with Department patent regulations, of the ownership and manner of disposition of all rights therein and whether patent protection on such inventions shall be sought, and, if so, the manner of obtaining, administering, and disposing of the patents in the public interest; or (2) where the institution has a separate formal patent agreement with the Surgeon General covering inventions deriving from Public Health Service support, to make a determination of ownership and disposition in accordance with its policies as approved or as modified by such agreement. In no event, shall patent applications be filed on inventions reported under (1) above, without prior written consent of the Surgeon General.

The Public Health Service patent policy is a part of the terms and conditions of an award, and is accepted by the awardee and the institution when an application for PHS support is completed and signed. The grantee institution and the awardee have joint responsibility for abiding by Public Health Service patent policy. An applicant, candidate, grantee, or awardee is responsible for reporting any commitment or obligation entered into by any of these parties which would conflict with PHS patent policy. Early reporting of inventions is required, that is, no later than at the time a manuscript is prepared for publication.

Progress reports, which may include descriptions of possibly patentable inventions, may not substitute for formal reports of inventions.

II. Annual Invention Statement

An Annual Invention Statement must be provided as part of the request for continuation or renewal of each type of Public Health Service grant and award. This statement must be submitted even if no invention has occurred during the current period of grant support for which continuation or renewal is being requested, and even if an invention to be reported was only partially supported by Public Health Service funds. The statement should include all inventions which might possibly be construed in any manner to be Public Health Service grant or award-supported or related. Neither continuation nor renewal of a grant or award will be paid until the Invention Statement has been received.

An Annual Invention Statement must also be submitted covering the terminal period of an award for which no renewal is planned.

continued

III. Amended Patent Agreement

In the following instances, procedure requires the completion of an Amended Patent Agreement, which, when signed, becomes a part of the terms and conditions of a grant or award:

A. Where the institution proposes to subcontract with a commercial organization for a portion of the research to be conducted under the grant.

B. Where the investigator proposes to submit compounds to be synthesized and/or developed with Public Health Service support to a commercial company for screening purposes.

Any questions regarding inventions and patents should be addressed to the Special Assistant (Extramural Patents), Division of Research Grants, National Institutes of Health, Bethesda 14, Maryland.